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THE

British Fire Prevention Committee.

(*Founded 1897.—Incorporated 1899.*)

RULES.

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NOTE.

These Rules are based on the Memorandum and Articles of Association approved by the Board of Trade, the authority of which is final in any question under dispute. Any future alteration in the Rules involves a like alteration in the Memorandum and Articles of Association, and must be treated as such.

Copies of the Memorandum and Articles of Association can be had from the Secretary on application.

All communications regarding the Committee should be addressed to the Secretary.

RULES

OF THE

British Fire Prevention Committee.

(Founded 1897.—Incorporated 1899.)

Title.

The name of the Society is the "BRITISH FIRE PREVENTION COMMITTEE." (Founded 1897. Incorporated 1899).

Scope.

The scope of the Committee's work shall embrace all matters relating to Fire Protection, having special regard to the *prevention*, as distinct from the extinguishing of fires.

Objects.

The objects of the Committee are (*inter alia*):—

To direct attention to the urgent need for increased protection of life and property from fire by the adoption of *preventive* measures.

To use its influence in every direction towards minimising the possibilities and dangers of fire.

To bring together those scientifically interested in the subject of Fire Prevention.

To arrange periodical meetings for the discussion of practical questions bearing on the same.

To establish a reading room, a library, and collections for purposes of research, and for supplying recent and authentic information on the subject of Fire Prevention.

To publish from time to time papers especially prepared for the Committee, together with records, extracts, and translations.

To undertake such independent investigations and tests of materials, methods, and appliances as may be considered advisable.

To facilitate the formation of such independent sections or groups serving as centres for any of the special interests involved, to offer such technical information as these interests may require, and to issue notices, warnings, &c., for their especial benefit.

To retain skilled advisers for the inspection of buildings or appliances where independent advice is desired.

To promote, support, or oppose legislative or other measures connected with or affecting the aforesaid objects.

Constitution.

The Committee shall comprise a General Committee of Members, an Executive, a Council, four Vice-Presidents, and a President, and in connection with the Society there shall be such independent sections or groups serving as centres for the special interests involved as may be considered expedient. The functions of such sections shall be advisory to the Council and Executive.

Membership and Subscriptions.

In the case of those who are not invited to join the Committee application for Membership shall be made in writing to the Executive, and shall be accompanied by a statement of the candidate's qualifications, together with reference to any Member acquainted with the applicant or his work.

Members shall belong to the technical professions including architects and surveyors, engineers, chemists, and scientists generally, or shall be acting officers of the leading Fire Brigades, Government, County or Municipal officials, or the directors, managers, secretaries, or actuaries of Insurance Companies.

Members of Parliament, Members of County Councils, Municipalities, &c., interested in the subject, shall be invited to join the Committee, as well as leading manufacturers, large employers of labour, prominent commercial men, theatre managers, and others prominently connected with public entertainments, but their aggregate number shall not exceed one-third of the actual membership.

Honorary Members shall be British subjects of distinction whose work in connection with Fire Prevention shall, in the opinion of the Council, call for recognition, and no such Member shall be nominated otherwise than by three Members of the Council.

Honorary Foreign corresponding Members shall be foreigners distinguished in any branch of technical work pertaining to Fire Prevention whose co-operation may be of value to the Committee. Such Members shall be nominated by the Executive, and shall continue Members of the Committee for such period as the Executive may from time to time determine.

The terms of subscription for the Members of The British Fire Prevention Committee shall be One Guinea per annum, but the subscription shall be optional for such

original Members as the Executive may determine, and for such officials as hold permanent appointments with municipalities, County or District Councils, or the Government, and those Members elected under the two preceding Clauses.

All subscriptions for the current year shall be payable in advance on the 1st of January, when the financial year shall be deemed to commence; but in the case of Members who join after the month of October, their subscriptions shall cover the following year. Any Member whose subscription shall be in arrear for one month shall not be entitled to vote at any Meeting of the Committee until his subscription shall have been paid.

It shall rest with the Executive to determine an entrance fee on or after closing the list of original Members.

Each Member whose subscription has been paid is entitled to one free copy of such publications as shall from time to time be issued by or for the Committee on application to the Secretary for same, but the Executive are to be at liberty to send copies of any such publications to such Members or to any other persons not being Members of the Committee as they may consider are specially interested in the subject-matter of such publications.

The Executive shall be authorised to accept donations, either in aid of the general funds of the Committee, or to defray expenses which may be incurred in carrying out special undertakings connected with the Committee's work.

A Register of Members and their addresses shall be kept, and the name and address of every Member shall be written in such Register.

The name of every Member failing to pay his annual subscription due on the 1st day of January, shall be posted in a book kept for the purpose on the 1st February following,

and if the subscription be not paid on or before the 1st day of March, the Executive shall have power to remove the name of such defaulting Member from the Register of Members, and such defaulter shall then cease to be a Member of the Committee, and his name shall be erased from the Register of Members accordingly. The Executive may reinstate a Member on satisfactory grounds being shown for the failure of due payment.

Any Member intending to withdraw from the Committee shall signify his intention to do so in writing to the Executive on or before the 1st day of December in any year, and in default shall remain liable for the subscription for the ensuing year.

In the event of the work of the Committee being terminated, or the Committee being dissolved, the liability, if any, of each Member is strictly limited to £1.

If the Executive shall consider that any Member has been guilty of conduct injurious to the Committee or to the interests thereof, the Executive shall have power, after due inquiry, to remove his name from the list of Members, but no resolution of the Executive for such erasure of a Member's name shall be passed unless fourteen days' notice of the intention to propose a resolution to such effect be given to such Member, and an opportunity afforded him of answering any charges or complaints as to his conduct, and unless such resolution is carried by the votes of at least two-thirds of the Members present at the Meeting, and should there only be four Members of the Executive present at the Meeting, their decision must be confirmed at a second Meeting of the Executive held after the expiration of a fortnight from and within a period of six weeks after the date of the Meeting at which the first decision was taken.

If a Member's name shall be erased as aforesaid his subscription for the current year shall be returned to him, and he shall be informed by registered letter that his name has been so crossed off the Register of Members.

Council.

The Council shall consist of not more than thirty-six Members, with a President and four Vice-Presidents, all of whom shall be elected by the Committee, and in addition the Chairman and Members for the time being of the Executive, and the Chairman and Vice-Chairman (if any) of the special sections shall ex-officio be Members of the Council.

At each Annual Meeting of the Committee to be held as hereinafter mentioned, the President shall retire, but shall be eligible for re-election; the Vice-Presidents shall retire, but three shall be eligible for re-election; the thirty-six elected Members of the Council shall retire, but with the exception of six shall be eligible for re-election.

All final decisions as to the extent and character of the work of the Committee shall rest with the Council.

Not less than six Members of the Council are required to make up a quorum for ordinary questions of business, and not less than two thirds of the whole Council for matters pertaining to any alteration of the general purposes of the Committee.

The Executive.

The Executive shall be limited to twelve Members and a Chairman and a Treasurer, nominated by the Council, and elected by the Committee for a term of four years, at the end of which period the Members of the Executive shall retire; but the Chairman, Treasurer, and nine Members shall be eligible for re-election.

Each individual Member of the Executive shall be entrusted with that special branch of the work with which he is particularly conversant.

Not more than one-half of the Executive shall at any one time belong to the same profession.

Not less than four Members of the Executive, or the Chairman and two Members thereof shall form a quorum for the transaction of ordinary business, and not less than two-thirds for the discussion of matters affecting the general policy of the Committee, and all questions shall be decided by a majority, the Chairman in all cases of an equality of votes having an additional casting vote.

The Executive shall have power:—

To arrange all the Committee's work, and to carry out and effect the objects for which the Committee is established, and which are set forth in the Memorandum of Association.

To manage and superintend the affairs of the Committee.

To appoint their own Meetings and regulate their own proceedings.

To arrange Meetings of the Committee and to select papers for publication.

To arrange all business matters relating to the testing of materials or systems, the formation of a testing station, permanent or temporary exhibitions, the retention of advisers or inspectors, the drafting of parliamentary or local regulations, and also the issue of publications, notices, maps, warnings, &c., and shall make such financial arrangements as may be necessary, and for such purposes they shall be empowered to add to their number or form special Sub-Committees representative of the various professions primarily interested.

To act for all or any special sections, and arrange the work of the sections as for the Committee, but all Meetings, agendas, &c., of sections shall only be determined after consultation with the Chairman of the section concerned or his deputy.

To make such regulations and bye-laws as the Executive may deem necessary for the purpose of carrying out and effecting the objects for which the Committee is established, provided that such regulations and bye-laws shall not amount to such an alteration of or addition to these Articles of Association as could only legally be made by a Special Resolution.

Subject to these Articles to repeal or alter the regulations or bye-laws so made and to make new ones.

To delegate any of their powers and duties to any Sub-Committee appointed by them, and so that any such Sub-Committee may meet and conduct its proceedings as it may from time to time determine.

To supply any vacancy occurring in their own body during the intervals between annual Meetings by reason of death or absence, as hereinafter mentioned.

To institute and carry on or discontinue any legal proceedings in the name of tbe Committee, or of any of its officers or servants for the recovery of any debts or demands claimed by or on behalf of the Committee, or for the assertion of any actual or supposed rights or privileges of the Committee, and to defend any legal proceedings commenced against the Committee or any of its officers or

servants, and to pay out of the funds of the Committee any costs and charges incurred in connection with such legal proceedings.

To convene Special General Meetings of the Members of the Committee as hereinafter provided.

To borrow money and to give as security therefor, and for the interest thereon a mortgage or charge upon all or any part of the property of the Committee.

The Chairman of the Executive for the time being shall act as honorary secretary, and control the staff and office arrangements.

The Treasurer for the time being shall attend to all financial matters relating to the work and business of the Committee.

The Seal of the Committee shall not be affixed to any instrument except by the authority of a resolution of the Executive, and in the presence of at least three Members of the Executive, and such Members or three of them shall sign any instrument to which the Seal shall be so affixed.

If any Member of the Executive shall be absent from Meetings of that body for six consecutive calendar months without having given previous notice in writing to the Secretary of the Committee of his intention to be absent, he shall be considered by such absence to have tendered his resignation, and the Executive shall be at liberty either to consider such absence as a resignation or otherwise as they may think proper.

Auditors.

The accounts of the Executive shall be examined annually by two Auditors, one elected by the General Committee of Members, the other nominated by the Council.

Members of the Council or of the Executive are not eligible as Auditors.

Officials.

The permanent officials shall comprise a Secretary, an Assistant Secretary, and such Clerks as the Executive may deem advisable, and their appointment shall rest with the Chairman of the Executive.

Consulting Officials.

The Executive may call to their assistance certain professional men, paying them such fees as may seem fitting.

The selection of the bankers, solicitors, publishers, and accountants to the Committee shall rest with the Executive.

Meetings.

An Annual General Meeting, of which seven clear days' notice shall be given, shall be held in the month of December in each year for the purpose of selecting officers for the ensuing year and receiving the annual report.

The Council or the Executive may at any time convene a Special General Meeting of the Committee (and the Executive shall of necessity do so when requested in writing by not less than forty members) for any purpose whatsoever, of which at least seven clear days' notice shall be given to all Members of the Committee but such notice shall specify the purposes or objects for which such Special General Meeting is being called, and the business of any such Special General Meeting shall be confined to the objects expressed in the notice convening the same.

There shall be not less than six Ordinary General Meetings of the Committee annually, to be held on Wednesdays, for the purpose of reading and discussing papers and communications. The dates of these Meetings shall be determined by the Executive.

The Meetings shall be held alternately at 4.30 p.m. and 8 p.m. in the Lecture Room of the Royal Service Institution, or a similar lecture room near Charing Cross.

Meetings for the transaction of the Committee's business shall be held on such dates as the Executive shall decide.

No business shall be transacted at any General Meeting unless at least twenty Members are present.

At every General Meeting (other than those held for lectures, when a special Chairman may be invited by the Executive to preside) the President, or in his absence, the Chairman of the Executive shall preside, but if the President and the Chairman of the Executive are both absent from the Meeting, then some Member to be chosen by the Meeting shall preside.

The business to be transacted at the Annual General Meeting shall be :—

To receive the report of the Executive.

To confirm, if required, such of the proceedings of the Executive as may be subject to revision.

To appoint an Auditor of the accounts of the Committee for the ensuing year in compliance with Article 34.

To pass the Treasurer's accounts, the same having been previously audited by the Auditors.

To elect in every year a President and four Vice Presidents and thirty-six ordinary Members of the

Council, and in every fourth year to elect a Chairman of the Executive, a Treasurer, and twelve ordinary Members of the Executive.

To transact the ordinary business of the Committee

Votes.

Every Member shall have one vote and shall only give the same in person.

Every question submitted to a Meeting shall be decided in the first instance by a show of hands, and in case of an equality of votes, the Chairman shall, both on show of hands and at the ballot, have a casting vote in addition to the vote he is entitled to as a Member.

At any General Meeting, unless a ballot is demanded by at least five Members, a declaration by the Chairman that a resolution has been carried or carried by a particular majority or lost, or not carried by a particular majority, and an entry to that effect in the book of proceedings of the Committee, shall be conclusive evidence of the fact without proof of the number of the votes recorded in favour of or against such resolution.

If a Ballot is demanded as aforesaid it shall be taken in such manner and at such time and place as the Chairman of the Meeting directs, and either at once or after an interval or adjournment or otherwise, and the result of the ballot shall be deemed to be the resolution of the Meeting at which the ballot was demanded.

The Chairman of any General Meeting may, with the consent of the Meeting, adjourn the same from time to time and from place to place, but no business shall be transacted at any adjourned Meeting other than the business left unfinished at the Meeting from which the adjournment took place.

Any ballot duly demanded on the election of a Chairman of a Meeting or on any question of adjournment, shall be taken at the Meeting and without adjournment. The demand of a ballot shall not prevent the continuance of a Meeting for the transaction of any business other than the question on which a ballot has been demanded.

Notices.

A notice may be served on all Members of the Committee by circulars delivered to them personally or sent to them through the post in prepaid letters addressed to them at their registered place of abode, and in the latter case, circulars shall be deemed to have been delivered on the day next after the day on which the same shall have been posted, but the non-receipt of a circular by any Member shall not invalidate the proceedings of any Meeting.

The notice required of any proposal for making, repealing, or altering any Rule shall be seven clear days, and the notice sent to each Member shall contain a copy of every proposal for making, repealing, or altering any Rule whether originating with the Executive or not.

Alteration of Rules.

No Rule shall be repealed or altered, nor shall any addition to the Rules be made except by special resolution in accordance with the definition following, that is to say:— A resolution passed by the Committee shall be deemed to be special whenever a resolution has been passed by a majority of not less than three-fourths of such Members of the Committee for the time being entitled, according to the regulations of the Committee to vote, as may be present in person at any General Meeting of which notice specifying the intention to propose such resolution has been duly given, and such

resolution has been confirmed by a majority of such Members for the time being entitled, according to the regulations of the Committee, to vote, as may be present in person at a subsequent General Meeting of which notice has been duly given and held at an interval of not less than fourteen days, nor more than one month from the date of the Meeting, at which such resolution was first passed, All other matters and questions at any Meeting shall be decided by a majority.

Publications of the

BRITISH FIRE PREVENTION COMMITTEE.—No. 1.

What is Fire Protection?

A Study

BY

EDWIN O. SACHS,

ARCHITECT,
FELLOW OF THE ROYAL STATISTICAL SOCIETY;
AUTHOR OF "MODERN OPERA HOUSES AND THEATRES,"
"FIRES AND PUBLIC ENTERTAINMENTS,"
ETC., ETC.

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One Shilling.

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NOTE.

In complying with the request to prepare the first paper for this series of publications, I was aware that some general remarks on the subject under consideration of the Committee would be required. Hence I have avoided dealing with any one of the many sections into which the question of fire protection can be divided, and have only attempted to explain the scope of the subject without referring to the work of individual persons, bodies or communities, and without making comments or tendering suggestions. In fact, I have been particularly careful to avoid the mention of names, and to abstain from saying that which might read like a preference or partiality.

These pages are only intended to summarise some of the many sections alluded to, and to recapitulate a few of the more important theories and methods promulgated or practised at home and abroad. If I may say so, there is also, purposely, no new matter introduced into these pages. The short notice given for the preparation of this study would alone have prevented my bringing forward new aspects of the matter had I wished it. I cannot but point out that nearly every sentence is more or less a repetition of what I have said before when speaking of Fire Protection. And yet, perhaps, just this repetition of facts may be more

useful in the early stages of the Committee's work than arguments on some specific points or features of the subject.

Our annual loss of property by fire is enormous; several statisticians place the amount of this loss in the British Isles at £7,000,000 per annum; and yet very little has been done to lessen this waste. Our annual death-roll is also serious; nevertheless, no effective remedy has yet been introduced. One of the reasons for this state of affairs is that but few appreciate the full meaning of fire protection as practised so successfully by several nations whose increasing prosperity is to some extent, due to the sound economy insisted upon in all directions. The minimising of fire losses will, however, soon have to become an important factor in the work of our communities, for many are tiring of the constant havoc wrought by fire. Before, however, we can hope to reform this state of things, it is necessary to appreciate fully the question: What is Fire Protection? And I trust that the following pages, though containing nothing that is new, will contribute somewhat in this direction.

EDWIN O. SACHS.

London,
November 1st, 1897.

What is Fire Protection ?

INTRODUCTION.

I SHOULD first explain what I understand fire protection to be. The term is, I am afraid, too often misunderstood. Fire-extinguishing—in other words, fire brigade work—is what the majority have in their mind, and many towns consider themselves well protected if they can boast of an efficiently manned fire-engine establishment. In reality the fire brigade as such has but a minor *rôle* in a rational system of protection. Really well-protected towns owe their position in the first place to properly applied preventive legislation based on the practical experience and research of architects, engineers, and fire experts, insurance, and municipal officials.

The term Fire Protection.

Fire protection, as I understand it, is a combination of fire prevention, fire combating, and fire research. Under the heading of "Fire Prevention," I class all preventive measures, including the education of the public; and under the heading "Fire Combating," I class both self-help and outside help.

Preventive measures may be the result of private initiative, but as a rule they are defined by the local authority, and contained partly in Building Acts, and partly in separate codes of fire-survey regulations—supplemented, if necessary, by special rules as to the treatment of extraordinary risks, such as the storage of petroleum, the manufacture of explosives, and the performance of plays.

Preventive Legislation.

Education of the Public.

The education of the public I speak of may be simply such as can be quite informally commenced at school and continued by official or semi-official warnings, and a judicious arrangement with the ever-powerful Press as to the tendency of their fire reports.

I am not writing in the abstract, as such forms of training have already been successfully introduced. I know of towns where the authorities have, for instance, had some of the meaningless fables of the Board School "Standard Reader" replaced by more instructive ones, which warn children not to play with matches, and teach them to run for help in case of an emergency. Instructive copy-book headings have been arranged in place of the meaningless sentences so often used in elementary schools. There are quite a number ot municipalities where regular warnings are issued, to take an instance again, every December, as to the dangerous Christmas-tree. In such places every inhabitant has at least an opportunity of learning how to throw a bucket of water properly, and the neatest way to trip up a burning woman and roll her up without fanning the flames. The householder is officially informed where the nearest fire-call point is, and how long he must expect to wait till the first engine can reach his house. If he is a newspaper reader, he will also have ample opportunity of knowing the resources of his town, and the local reporter's fire report will give him much useful information based on facts or hints supplied by the authorities.

I mentioned, just above, I classed both self-help and outside help under the heading of "Fire Combating."

Self-Help.

The self-help I speak of, mainly deals with the protection of large risks, such as factories, stores, public places of amusement, where it lends itself to regulation. The requirements of the fire survey code may allow for the arrangement of hydrants in certain risks, and also for their regular inspection, and the means for self-help may thus be given. These means will, however, probably not be properly employed unless some of the

employés engaged on the risk are instructed as to their purpose, and have confidence in the apparatus at their disposal. The possibility of proper self-help in dangerous risks may be encouraged by enforcing regular drills for the *employés*, and regular inspections to test their efficiency. There are towns where great reliance is placed on the efforts of such amateur firemen. In some cities they even receive extra pay and are formed into units, properly uniformed and equipped, and retained by the fire brigade as a reserve force for emergencies.

Self-help for the shopkeeper, the lodger, or the householder can scarcely be regulated. The opportunities I mentioned above under the heading of "Public Training" would already assure an intelligent behaviour on the part of a large percentage of the community. I know places where, without any regulation being attempted, and thanks entirely to the influence referred to, most residences can boast of a hand-pump, a bucket, and a crowbar, the proper use of which is known to most of the household. Self-help in small risks may, however, be distinctly encouraged by the authorities, without any irksome interference with personal liberty, simply by the provision of street pillar-boxes, with the necessaries of first aid, including perhaps a couple of scaling ladders, and, further, by opportunities being given to householders to learn how to handle them. Put a street pillar-box of this kind in a fire-station, reserve certain afternoons in the year on which this elementary instruction will be given, and the students afterwards shown over the fire-station, or treated to a "turn-out," and there will be quite a number taking advantage of the occasion. No matter whether curiosity or real interest brings them there, the object in view will be attained.

When I speak of outside help I, of course, in the first place, mean organised outside help, and not simply such as is tendered by the casual passer-by or a neighbour. The link between self-help and outside help is the fire-call.

The Fire-Call.

The efficiency of the fire-call depends not only on the instrument employed and its position, but also on its conspicuous appearance and the indications given to find its whereabouts. These indications are quite as important as the instruments themselves. The conspicuousness of the instrument alone does not suffice. Of the official notifications given in the Press, those in regard to the position of the call-points are among the most useful. An indication at every street corner as to the direction to take to reach the point—or perhaps better, as I also know it, the conspicuous advertisement of the nearest call-point over every post pillar-box and inside every front door—may enable the veriest stranger to call assistance, and minimise the chances of time being lost in search of the instrument. I will not now refer to the instrument itself It is immaterial for the moment if the helpers are called by a bell outside a fire-station, by a messenger from some special messenger service, a call through a telephone, or an electric or automatic appliance. Any instrument will do that insures the call being transmitted with a maximum speed and certainty, and in full accord with the requirements of the locality.

Outside Help.

As to the organised outside help, it may not be limited simply to the attendance of the fire brigade. Special arrangements can be made for the attendance of the local police force, a public or private salvage corps, an ambulance, or, in cases a military guard. Then in some instances arrangements are made for the attendance of the water and gas companies' servants, and even officials from the public works' office, insurance surveyors, and the Press. I know places where the salvage corps arrives on the scene almost simultaneously with the fire-brigade and others where the police are generally on the spot in good force five minutes after arrival of the first engines. There are two cities where the ambulance waggon and the steamers arrive together, and another city where the military authorities always send a fire piquet which can be turned out in a few minutes.

If all these helpers come together, and no matter how high the rank of the individual commanders, the senior officer of the fire brigade, even if he holds only non-commissioned officer's rank, should have the reins, and his authority be fully recognised. Unfortunately there are not many places where this is the case; I would, however, insist on this fact, that the efficiency of outside help depends in the first instance on clearly defining the duties and powers of all concerned, the legal foundation, in fact; then on the organisation, the theoretically as well as practically correct executive, and, last, but by no means least, the prestige, the social standing, the education of commanders and their ability to handle men. For the rank and file of the brigade, clear-headedness, pluck, smartness, and agility will be as invaluable as it is dangerous to have reckless dare-devilry, showy acrobatism, or an insane ambition for distinction among the members of the force. Definition of Powers.

Under the heading "Fire Research" I include all theoretical and experimental investigation as to materials and construction, combined with the chronicling of practical experience in fires, then the careful investigation and chronicling of the causes of fires, assisted where necessary by a power of fire inquest for interesting, suspicious, or fatal cases. I also include experimental investigation as to natural and accidental causes as distinct from criminal causes. Research for criminal cases may not only be assisted by a fire inquest as we understand it, but also by immediate formal inquiries held on the spot, by the senior fire brigade and police officers present, or by immediate Government investigations held on the same lines as inquiries into explosions. As to general research work I would mention that there are several cities where, of late years, a number of experts have been regularly employed to superintend a series of experiments on the resistance to fire of iron, steel, wood, and stone. Some towns have special commissions of experts who visit all big fires which occur within a day's travelling distance, take photographs Investigations.

and sketches, and issue reports as to how the materials were effected. Then there are the usual statistics as to outbreaks, their recurrence and causes, and in some places such tables are supplemented by reports on experiments with oil lamps, their burners and wicks, electric wiring, and the like.

I have stated that "Fire Protection" consisted of "Fire Prevention," "Fire Combating" and "Fire Research," and I have tried, that is, to explain to the best of my ability what these headings cover. Before entering into detail, I shall touch on the financial aspects of such protection, and mainly its relation to the public purse.

FIRE PROTECTION AND FIRE LOSSES.

Distribution of Losses.

We all know that property destroyed by fire is practically an absolute loss. This loss may only actually affect the owner, or it may be distributed among a number of people who are taxed for it in the form of a contribution to their national or local fire fund, a share in some mutual insurance 'ring,' or the more usual insurance companies' premium. In the first two cases there are also some expenses to subscribe to in connection with the management of the fund or 'ring.' In the latter case, not only the expenses of management have to be covered, but also the costs incurred in running the insurance enterprise as such, and then a further amount for division amongst those who share the risk of the venture —in other words, the insurance company's shareholders.

Loss and Expenditure.

We must here distinctly discern what is a loss and what is mere expenditure. The sinking fund of the large property owner should cover a loss with a minimum extra expense ; insurance in an extravagantly managed company paying large dividends will cover a loss, but with an unnecessarily large extra outlay. In every case the loss remains ; and as property may always be considered part of the community, province or nation, as the case may be, suffers. It is always in the interest of a nation

to minimise its national losses, no matter whether they fall on one individual's shoulders or on many, and whether such losses are good for certain trades or not.

The Practical Minimum.

With a suitable system of fire protection it is possible to bring these losses to a minimum, but this minimum would probably only be reached by an extra expense, which would fall heavier on the insurers' pockets in the form of municipal rates than the higher premium for the greater risk. A *practical* minimum is all that can be attempted, and that *practical* minimum varies according to circumstances. Most property-owners would, I believe, grumble if a greater immunity from fire were to cost them much more than the danger. They would prefer the risk of the heavier loss to an extra annual expenditure.

Practical Protection and Insurance.

Practical protection must mean smaller annual insurance dues, and the actual extra cost of this protection should be something less than the saving off these dues. Then the nation not only has a smaller dead loss, but the owner also has a smaller annual expenditure for his combined contribution towards the losses, the management of his insurance, and the protective measures. Where there is mutual insurance or municipal insurance in its best sense, the losses by fire and the costs of the protection are often booked in one account, and the better protection up to a certain point should mean a smaller individual annual share. Where there is company insurance the municipal rates are increased to cover the cost of extra protection, while the insurance premiums are expected to proportionately decrease. Competition and public opinion generally force this decrease of the insurance rates as soon as there is a greater immunity from fire. Where the insurance companies are well managed, and the shareholders are satisfied with reasonable dividends, *practical* protection can be said to find favour with all concerned, but if the protection is arranged for and the companies do not moderate their charges accordingly, the result for the property owner is by no means a pleasant one.

Maintenance of Fire Brigades.

I may as well at once touch here on the question of insurance companies subscribing towards the maintenance of a fire brigade. The argument municipalities use is to the effect that the insurance companies derive all the profit from a good fire service, and should contribute towards its cost. Now, as just said, where properly managed companies have the business, a better fire service means a smaller premium to the ratepayer. If the ratepayer has to pay for extra protection in form of an increased municipal rate, or in form of an increased premium raised to meet the contribution levied, surely it is simply juggling with figures. Of course I know full well that the contribution in the latter form helps to popularise the municipal budget, but surely this is not of any real account. Now this is all quite independent of any argument in favour of fire protection being considered in the same light as police protection or sanitation, which are everywhere held to be ratepayers' affairs in the fullest sense of the expression. We do not hear of municipalities in want of a popular budget asking burglary and life insurance companies respectively to contribute to the expenses of their police force or sanitary department.

Municipal Insurance and Protection.

To refer here to the advantages and disadvantages of municipal insurance in connection with this study would lead too far, and I scarcely hold the question to have any considerable bearing on the subject. At the most, to my mind, such municipal insurance could only further the actual protection by the opportunity it would give the authorities to fully realise the extent of the losses and the effect of their efforts. Any saving accruing for the ratepayers owing to shareholders' dividends and other extra costs not having to be covered in the insurance premiums, should not affect actual protection. Of course, the municipal insurance premiums may be so figured as to leave the authorities a revenue which is devoted to protective measures. This again, however, is generally only done to reduce municipal rates and juggle with figures. The protection actually required remains the same, and the ratepayer will have to pay for it, no matter in what form.

Municipal Insurance.

I am no friend of municipal insurance if planned with the idea of obtaining a revenue from it, and I do not even consider that a general fire insurance business lends itself to official management. I, however, know a number of cities where the authorities limited themselves to taking house risks only, and most satisfactory results were thus obtained. In these cases, the chief ambitiсn of the authorities was simply to arrange for a maximum distribution of losses, a rapid re-erection of buildings gutted and a reduction of the ratepayers' insurance expenses. Mortgages on house property were facilitated and a reduction of criminal cases obtained.

THE COST OF FIRE PROTECTION.

Building Regulations and Fire Survey.

As to the actual extra cost of a practical system of fire protection above that of the more usual merely combative establishment, I can only say that where changes for the better were made, it was really astounding how cheaply the greater immunity from fire was obtained. In the first place, I would point out that the special fire clauses embodied in a Building Act would, of course, be attended to by the same executive authorities who would in any case superintend general structural matters, and that the additional work would at the most require some increased clerical aid. If the execution of the fire survey regulations were delegated to the same authority, there would again simply be some extra clerical aid to pay for, and the salaries of perhaps a few extra surveyors. To make the inspections thoroughly efficient, it has been found advisable in instances to form parties of three for the rounds. The second man would, in this case, be a fire brigade officer, and the third probably a master chimney sweep, who would have to receive a special retaining fee.

Training of the Public.

The cost of the public training I referred to would be small, as the elementary part would simply be included in the schoolmaster's work, and the Press matters could

be easily managed in the fire brigade office. Payments would only have to be made for advertisements, such as the official warnings, lists for fire-call points, etc., and perhaps for the publication of semi-official hints. Self-help, as far as inspection and drills for amateurs are concerned, would be in the hands of the fire brigade. There would, however, be an extra expense for the purchase and maintenance of the street appliances to which I referred.

Fire-Call.

The most expensive items in the system of fire protection undoubtedly come under the headings "Fire-Call" and "Fire Brigade." As to the former, however, I would mention that there are quite a number of cities where the cost is modified by having the whole of the electrical service for the police force, the ambulance and fire brigade, managed by a separate municipal department. The same wires call up each of these services, and as the same staff attend to their maintenance, the fire protection of a city need only be booked with perhaps a third of the outlay it would occasion if managed independently. The combined system has also the great advantage of facilitating the mutual working of the different services in case of an emergency. The indicators which I have referred to, of course, also involve an outlay; but here again, if the three services work together, the expenses on the count of fire protection can be lessened. Speaking of money rewards given in some cities to individuals who first call the fire-engines, I would point out that such gratuities can become a heavy item, and I have some doubts if in reality they do much good.

Fire Brigade.

As to the outlay on fire brigade establishment, I would here only say that I am a friend of systems which allow for a strong active force supported by efficient reserves. The latter should be as inexpensive as possible, but by all means at least a part-paid and disciplined body which could be easily called in for emergencies. Fire brigade budgets cannot allow for an active force being ready for such curious coincidences as an unusual number of large

fires starting simultaneously, but they must allow for an ample strength always being forthcoming for the ordinary emergencies, and this with all due consideration for men's rest and possible sickness. An undermanned fire brigade is an anomaly which is generally fatal not only to the property owner, but also to the whole efficiency and *esprit* of the force. The budget must also allow for an attractive pay, as the profession is one which requires men who have a maximum of sterling qualities which we look for in the pick of a nation. It must also not be forgotten that the fire service is one of the few where a system of pensions is the only fair way of recognising the risks of limb and health, and at the same time influencing that stability of a force in which practical experience from long service is so essential. The budget must allow for an ample reserve of appliances.

Salvage Corps.

Whether a fire brigade should be so strong as to permit of its having a separate section for salvage corps purposes depends on circumstances. I, at all events, hold that if a salvage corps is required, it should be part and parcel of the municipal brigade organised on the same lines with a reserve, no matter whether the insurance of the locality be managed by the authorities or by the companies. Again, if the corps is necessary, it matters little whether it be paid for out of premiums or out of rates. To my mind there would, however, not be very many towns where a special salvage section would find sufficient work, taking it for granted that general protective measures are good, and that the tactics of the firemen are such as will give no occasion to fear an unnecessary water damage.

Investigation.

Of further expenses which have to be considered, there are items for fire research and fire inquest. If managed economically, due confidence being placed in the opinions of the fire officers and surveyors, there is no reason why the outlay should be great. The statistical work would only require some clerical aid. Where special coroners are retained for criminal cases some extra money will, of course, be required; but even here the costs need not be

excessive, as there are many retired fire brigade officers and fire surveyors who are well suited for the work, and would be satisfied with a small emolument.

Water Supply.

The last items I wish to enumerate relate to water supply. There are but few places where special fire high-pressure mains are laid on in the interests of fire protection. As a rule the costs which are debited to the heading "Fire Protection" have simply to cover the maintenance of hydrants and tablets, or at the most the cost of the water actually used for fire-extinguishing purposes. Sometimes the cost of hydrants is shared with the scavenging department or the Commission of Sewers, who also have the use of them. Where the provision of water and hydrants falls to a private water company, the property owners will, of course, be paying their share for them, indirectly, in the form of water rates.

Safe Construction, and Property Owners.

Now, it will have been noticed that all the expenses referred to are such as to my mind fall on the public purse, and that I have not taken into account the actual cost of the better construction or arrangements which the Building Act and fire survey regulations would require. The property owners would have to cover this expense individually, but I shall not call it a special or extra outlay, as I consider that stability, with due attention to sanitation and fire protection, should be the essence of modern building construction. Surely inferior construction not only shortens the life of a building, but it is also in every way detrimental to the interests of a *bonâ fide* investor. Safe construction enhances the value of a property, and the protective measures need not occasion much additional expense. Why not consider fire protection just as much a primary necessity for building as the block-signal system is for railway construction? Is there much difference in aiding a man's death by fire and his death in a railway accident? Why consider it more legitimate to spoil your neighbour's property by fire than to steal it? Bad construction means a risk to one's neighbour's life and property as

well as to one's own. It may not only cause a direct loss, but also spoil the man's business for years, and throw those out of employment who are dependent upon him. Why permit injuries of this kind?

Safety of Life and Safety of Property.

Now, this is the first time I have in any way distinguished between the safety of life and the safety of property. The protection of property, to which I may have seemed to be specially referring, must in any case include measures for the protection of life, as no fire can originate without there being some personal danger. It is practically immaterial if this danger affects the inmates or the firemen. The protective measures will serve for both and means for life-saving must be forthcoming as soon as possible after an outbreak has been signalled, as the helpers themselves may want them quite as much as those in or near the risks attacked. It should also be remembered that both a good staircase and a ladder are often quite as useful for the manœuvring of the firemen as for life-saving purposes, and that they are practically quite as essential for the saving of property as for saving life. I do not hold that any distinction need be made between the two risks when speaking of fire protection in general; but as the safety of a single human life must always be classed higher than that of the most valuable property, it may be well to give life-saving the first place when alluding to the two separately.

Criminal Fire-raising.

Up to the present it will have been noticed I have practically only referred to the prevention of fires originating from natural causes, negligence, or accident. Criminal fire-raising may seem not to have had sufficient attention. To my mind there is little or no criminal work where a perfect system of fire protection has been introduced. What with good construction and a fire survey, the quick arrival of the firemen, and careful inquests, the risks of detection are by far too great to encourage its growth.

FIRE PREVENTION.

Protection of Life.

Under "Fire Prevention" I first referred to the special requirements of the Building Act, the clauses of which can greatly influence the safety of life by requiring practical exits and sufficient staircase accommodation. I cannot here specially refer to the risks in theatres and assembly halls, which, to my mind, require separate legislation; I simply speak of factories, offices, business premises, hotels and tenement houses. In no case should any inmate of a building be more than sixty feet away from a staircase, and preferably there should be two staircases at his disposal in the event of one being blocked. Generally, attention is only given to the construction of staircases; but it must be pointed out that their ventilais equally important. Smoke is even a greater danger than fire, and may hamper the helpers terribly. The possibility of opening a window has saved many a life.

Protection of Property.

As far as the protection of property is concerned, the prevention of outbreaks can be influenced by the careful construction of flues, hearths, stoves, and in certain classes of buildings by the construction of floors and ceilings, the arrangement of sky-lights, shutters, and lightning conductors. Then comes the prevention of the fire spreading, first, by the division of risks; secondly, by the materials used in construction.

Adjoining Hazard.

When I speak of the division of risks the legislator's first ambition must be to prevent a fire in one house spreading to another, and a stranger's property, so to say, being endangered. This is quite possible, given good party walls carried well over the roof to a height regulated by the nature of the risk, the arrangement of shutters to windows where necessary, or the use of fire-resisting glass, again, a thoroughly good roof—or, still better, a fire-resisting attic floor—can do much. If the

locality has a fire brigade, and the force is decently handled, "spreads" from one house to another should never occur. Narrow thoroughfares and courts are however, a source of danger which may baffle all efforts to localise a fire. This should be remembered by those responsible for street improvements.

Division of Risks.

The division of a building or a large "risk" into a number of minor ones is only possible to a certain extent. I do not hold with spending enormous sums in order to make each of the minor "risks" impregnable. Our desire should be simply to try to retard the spread for a certain limited time after the flames have really taken hold of the contents. In those minutes most fires will have been discovered, and, where there is an efficient fire-extinguishing establishment, a sufficient number of firemen can be on the spot to localise the outbreak, and prevent the conflagration being a big one.

Slow-Combustion Construction.*

Take a drawing-room in an ordinary well-built house. If the joists are strong and the boards grooved, if some light plugging be used and the plastering properly done, if the doors are made well-fitting and fairly strong, a very considerable amount of furniture and fittings can remain well alight for half-an-hour before there is a spread. In a warehouse or factory "risk" the same holds good. With well-built wooden floors, thickly plugged, and the ceilings perhaps run on wire netting instead of on laths, with ordinary double-ledged doors safely hung, at the most perhaps lined with sheet iron on asbestos cloth, a very stiff blaze can be imprisoned for an hour.

Non-Combustion Construction.

The general mistake of using expensive iron and concrete construction is its aptitude to allow some breach being made through which the fire spreads. The iron door bends, and so does girder work. Then, again, directly a fire has obtained a hold, the composite floors are much too dangerous for the firemen to work on or under. The men cannot get near enough to the actual

* I believe that in one country "slow combustion buildings" is spoken of, an excellent term, as the expression "fire proof" is a misnomer, and "fire proof" buildings are impossible for practical purposes.

seat of the fire. Further, there is the extra danger of a stream of water touching hot iron, or the falling of a weight causing a general collapse, and after the fire has been extinguished, the ironwork is generally so damaged that it requires entire renewal, and the brickwork is probably so strained and bulged that the re-erection has to be commenced from the footings. The simpler forms of construction are generally the more satisfactory, and I should mostly advise it as an architect. The few iron and concrete floors, for instance, which will stand severe strains, are to my mind too expensive to allow their introduction for fire protection alone, and when I speak of their cost, it must be remembered that it is not only the expense of the floors which has to be considered, but also the extra outlay for stronger supports and foundations.

By-the-by, when speaking of the separation of minor "risks," the dangerous lift wells, skylights, and shaft openings should not be forgotten. The latter should be as small as possible, well armed with shutters, the skylights should again have fire-resisting glass, and the lift not only vertical doors, but also horizontal flaps, which would cut up the well into sections.

Structural Requirements.

Divisions of "risks," common-sense construction, and proper staircase accommodation are really all that fire protection requires, and where the special Building Act clauses have been kept within the lines I have indicated, there has been little friction and discontent. It is only when, to quote an instance which I have known, a tenement is required to have a large passage-way, through which a fire-engine could gallop into a court-yard, that the property owner very rightly considers himself harassed by protective measures.

Fire Survey Regulations.

As to the fire survey regulations, they should mainly prevent the actual outbreak of fire. In certain classes of risks fire survey can also increase the personal safety of the inmates, and the possibility of a fire spreading may be lessened. The provision of fire-escapes or ladders, and a regular inspection of their efficiency, will do much. The

examination of a rusty door-catch may save a building, The actual preventive work of the surveyor will, however, mostly consist in the warning of property owners against temporary stoves standing on ordinary floor boards, sooty chimneys, badly hung lamps, dangerous burners and gas-brackets fixed in risky positions. Self-help will be greatly facilitated by the judicious arrangement of fire-extinguishing gear, and a like inspection of its efficiency. Hydrants and cocks must not rust, nor must the hose get so stiff that water cannot pass through it. Hand pumps and pails must always stand ready filled. As to distributing such apparatus, I would point out that one of the greatest errors generally made is to forget that the amateur likes to have an easy retreat if his efforts are unsuccessful, and if this is not the case, he may not, perhaps, use the gear at all.

Special Risks.

It is, unfortunately, quite impossible in this pamphlet to touch on regulations governing "special risks" I referred to. I will only here say that as far as the safety of the public in theatres and public assembly halls is concerned, attention, to my mind, should be chiefly given to the exits. Spread of fire, and even its outbreak, are secondary considerations. A panic caused by a suspicion of fire can be quite as fatal as where a conflagration is actually started. As to the petroleum storage in shops, I would give most attention to prevent any direct communication between the shop or cellar and the main staircase or the living-rooms. As to the lamp question, why not prohibit the sale of dangerous lamps and burners in the same way as the sale of dangerous food?

FIRE COMBATING.

SELF-HELP.

Organised Self-Help.

As to self-help, I would only add that complications must always be avoided, and that above all the amateur fireman must be drilled on the simplest lines. I am a

great friend of competition where volunteer work is concerned, and have always found annual prizes to be a good investment. One thing, however, must be instilled into the amateur mind, and that is not to waste water—a sure sign of lack of training. Of course, the drills must be on the same lines as those of the local brigade, and on no account should other gear be used for self-help than is generally customary in that force. When volunteers and regulars work together, the latter should always remember that the paid force are experts, though the regulars must never have that contempt for volunteer work so often noticeable. Volunteers are men who are probably experts in some other vocation outside fire fighting, and have not had the opportunities which a professional fire fighter has had.

Independent Self-Help.

There is one point still regarding self-help which I may touch on. There are authorities who dispute the advantages of both organised and independent self-help, and who prefer the immediate call of outside help only. These authorities remember the futile help of the amateur, and perhaps the door he opened which fanned the flames before there was a sufficient supply of water to counteract the effect. When there is more than one helper at hand, one should always see that the regular fire brigade is called, and where there is one man only, he should never attempt self-help if the fire is well alight, but call the engines. If the fire, however, is small, and engines cannot be had within a few minutes, self-help should always be tried. Of course, so much depends on the circumstances, and also on the nationality and temperament of the first comer. Except for one or two countries where the amateur is apt to be too excitable, I hold that self-help, both organised and unorganised, should be encouraged.

FIRE-CALL.

Direct Calls.

I must now give some space to the invaluable fire-call. There are several methods of transmitting the message. The simplest is, of course, to run direct to the nearest

fire-station; but this is only possible where the distance is quite short. In one or two cities, however, the number of fire-stations is so great that they are very close to one another, and hence what I will term "direct" calls are generally recorded.

Special Messengers.

Then comes the system of special messengers. The fire is reported at some public office, police-station, or guard-room, where there are always runners ready to start off to the nearest fire-station. The special runner is, of course, here practically a makeshift for the more modern telegraph or telephone line, and the only city in which I know this system to be employed is one where the unsettled political atmosphere has compelled the authorities to prohibit the construction of any telegraph line other than those for the use of the general postal service. Similar messenger services have, however, also been introduced in connection with the telegraphic signalling system. I refer to the private enterprises known as "general messenger" or "call-boy" services, which are organised for business purposes, and have the advantage of the fire-call and the police-call thrown in. In the same way as a cab can be signalled, a call may come for a fire-engine, and the ever-ready runner makes off to the fire-station instead of to the cab rank. As a rule, these messenger offices are near the fire-station. The combination is really rather a curious one, as it embraces the most advanced notions of giving every "risk" its own fire-call, and the somewhat ancient one of the special runner. I have often wondered why these messenger offices have no special wires to the fire-stations themselves.

The General Telephone.

Another system for facilitating the fire-call, relies entirely on the public telephone system, the terms of subscription to which may compel holders to forward fire messages if required to do so. This system allows for such development as the payment of retaining fees to porters in public and other buildings which have a night service, on condition that the fire-call shall be promptly despatched. The telephones are, perhaps,

even provided free, if they are not forthcoming; but it should be remembered that the service always goes through a General Telephone Exchange, which is, of course, open day and night.

Special Telephones.

Then there is the special telephone line system, where special wires are laid on to buildings which are practically open all the year round, direct to their nearest fire-stations, and some payment is again made for prompt attention. Sometimes the telegraph takes the place of the telephone, but this requires the porter or attendant to be specially trained to the work. To simplify matters, the buildings are sometimes provided with automatic fire-calls instead of telephones; but the principle of the system remains the same. In districts where there are few public offices, the list of buildings at which messages can be handed in, has been frequently augmented by a set of bakeries or apothecaries' shops, where night service is not unusual.

Semi-Public Street Alarms.

What may be termed semi-public street alarms, come next. Automatic fire-calls are put up in the street, but their handles are under lock and key, and the keys are only distributed among policemen, watchmen, or householders, and the messages can, hence, only be given by persons known to the authorities.

Public Street Alarms.

The public automatic street-call is the last on my list. It is the simplest system next to the direct message. Of course, I know that private automatic fire-calls or telephones can be laid on from dangerous risks, and there has even been an instance where an attempt was made to give every householder a private fire-call. This system is, however, unfortunately too extreme for the municipal purse. If in connection with some other paying enterprise, as in the case of the messenger services referred to, it would be a different matter, though it should also not be forgotten that too great a number of call points means a probable repetition of signals of the same fire. As every call should be answered, with two separate fires quite easily occurring about the same time in the same neighbourhood,

there is a risk of too many sections of the fire brigade being on the road to the same fire.

Position of Call Points.

As to the position of call points, they should not only be conspicuous, but they must also be in most frequented positions. Possibly, in some towns, a point in front of a church would be the best; in others, it may be more advisable in front of a public-house. It should always be remembered that every facility should be given to enable as many people as possible to know the whereabouts of the call points without any distinct effort on their part. Red paint may make a call pillar conspicuous by day, and a coloured lamp by night.

Indication of Call Points.

As to the indication I spoke of, the plate on every letter-box as to the whereabouts of the nearest call point is perhaps one of the best. The letter-box is one of the instruments most in use in a modern city, and hence the plate is read by many. In an Oriental town the public fountain would, however, of course, take the place of the letter-box. Plates put up inside every front door are somewhat extreme measures. In one city I saw small red darts painted on the glass of every street lamp, indicating the direction to be taken to find a street alarm. This sign, however, has the disadvantage of requiring a previous knowledge of its meaning. It is generally useless to a stranger in the town.

Rewards for Calls.

As to rewards paid to messengers, I know them to vary from one shilling to half a sovereign. In some places every call is rewarded—that is to say, even those to chimney fires—and this often results in an abuse of the privilege. I have actually known rogues to light bogus fires on the top of a chimney, and then run to call the engines. If a reward be given, a limitation should be made. In one town I know of, no relation or *employé* of the owner receives a reward. In other cities no rewards are given for calls to a fire in a dust-bin or a chimney. As to the value of the reward, of course it depends on the value of money in the respective countries.

False Alarms.

Here I must add a few words as to false alarms. No true fireman would be annoyed at a false alarm given by

mistake. The possibility of a fire, or the suspicion of one, are *bonâ-fide* reasons for a call which should not be discouraged. Malicious alarms should, however, be treated with the utmost rigour, as the absence of firemen from their stations always means an extra risk to life and property. More distant helpers may arrive too late. Combined "lynch law" and imprisonment has been adopted with good effect in one city I know. The rascal when caught was put over the pole of the engine and thrashed with a broad fireman's-belt, and after that he was handed to the police. Hard labour has had much effect especially when inflicted on persons of position. Only a short time back the son of a well-known mayor had a month's hard labour for a malicious call, and there was at once an abatement of the evil. Fines are a ridiculous punishment for this kind of offence. Where the punishment for malicious alarm is severe there need be no recourse to the semi-public automaton I spoke of, excepting perhaps in the veriest slums of a city.

Fire Intelligence.

The fire-call, should if possible, also be so constructed as to facilitate intercommunication between the scene of a fire and the headquarters of the fire brigade. Where the runner is employed or the telephone is used no special arrangements are required, but where the telegraph or automatic call point have been introduced, the apparatus must be adapted for this contingency. At some automatic fire-call points a few signals can be given, at others a telegraphic or telephonic transmitter can be applied. Much valuable time may be saved in this way when more assistance is required. On the other hand, I again know towns which make a point of keeping up a line of intercommunication for every fire, so that in case of an emergency part of the men in attendance there could be called away to help elsewhere. In some places the headquarters of a fire brigade are in communication with some watchmen on a neighbouring tower or steeple, who can signal any increase in a large fire by the change of the "light" the blaze shows.

FIRE BRIGADE.

The organisation of fire brigades varies greatly. As to the hours of duty, there are brigades where officers and men are practically constantly ready to attend a fire, and others where they are ready on alternate days, two days out of every three, or three days out of every four, and the off day is entirely their own, or at the most, only partially used by the authorities for some light work. The men off duty are only expected to attend a fire if there is a great emergency. The brigade is strong enough without them for ordinary eventualities. Both systems can be worked with or without part-paid or volunteer reserve. These would be only called out for great calamities. They could be organised as a practically independent reserve force, or the reserve men might be attached to sections of the regulars and mixed with them when the occasion arises, in the same way as our naval reserve men mostly are. The reserves can either consist of retired firemen who have a few regular drills, or amateurs who have to go through a special course of training, have some series of drills at intervals, and preferably a short spell of service every year with the regulars. I prefer the reserves to be a distinct body. As regards the hours of duty for the regulars, forty-eight on to every twenty-four off has given the most satisfactory results. Working Hours of Staff Reserves.

As to the division of the active force, it may be on a system of a number of small parties of twos and threes backed by one or more strong bodies. Another system allows for sub-division into sections of equal strength, ranging from parties of, say, five men with a non-commissioned officer to thirty non-commissioned officers and men with an officer. The force can, of course, also simply be divided up into parties or sections of different strength not governed by a system of military units. The sections can either work independently, as units, simply governed by one central authority, or there can be a grouping of the units into minor or major bodies Division of Staff.

or districts, each duly officered, and as a whole individually responsible to headquarters.

Officers

As to the officers, they may be all taken from the ranks, or they may be "officers and gentlemen" in the military sense, who have only temporarily done work with the file when in training. There could also be a combination of these two systems. Only the captain and deputy-captain might be officers in the military sense, the sections or divisions being officered by "non-coms. Some cities have an officer to every thirty non-coms" and men, whilst others put a division of as many as two hundred under a fireman who has risen from the ranks. Where protection is treated as a science, and where those in charge of a brigade have really to act as advisers to their employers, officers in the military sense have been found essential. They have also been fonud advantageous where their scope is limited to fire extinguishing. The prestige of the fire service has been raised everywhere where the officers, besides being fire experts, are educated men of social standing. There are cities where the officers of the fire brigade are in every way recognised as equal to army or navy men, their social position is the same, and their mess fulfils the same functions as a regimental mess. The fire brigade officer is recognised at Court, and there is no ceremonial without him. On the other hand, there are also cities with brigades several hundred strong where the captain, who may, of course, be a very fine fellow, would unfortunately seem quite out of place in any recognised club room. His social standing would be that of a petty officer or colour-sergeant. As to the primary training of a fire brigade officer, I may as well say that the best men have generally had some experience in another profession, such as the army, the navy, or the architectural and engineering professions, previous to their entering the fire service. Some brigades recruit from army officers only, and preferably from the Royal Engineers or Artillery regiments; others recruit from among architects

and engineers, subject to their having at least had some military experience in the reserve forces or the volunteers. Some cities only take engineers or architects, and make a point of it that they should have no previous military experience. I hold that some previous experience in the handling of men is essential. Royal Engineers and architects or engineers of some military experience have, to my mind, nearly always made the best fire brigade officers.

Non.Coms. and File.

As to the men, there are cities where only trained soldiers are taken as firemen; others where the engines are manned by sailors. In some towns the building trades supply the recruits; inothers, all trades are either discriminately or indiscriminately represented. I have generally found a combination from the army or navy on the one side and the building trades on the other most satisfactory. The knowledge of building construction in the ranks stands the force in good stead, and has often saved both lives and property. Where a brigade can boast of a few men of each important trade, much money has been saved the ratepayers by the men doing their own repairs and refitting, but the number of men from sedentary trades should not be excessive. Where there are only men of one trade or calling, I generally found too great a tendency to one-sidedness, and a wonderful amount of prejudice.

I suppose I need not specially mention that physical strength and perfect constitution are requisite for both officers and men. As to the height of the men, I can only say that I have found small, wiry men to be very useful. First-class eyes, ears, and nose are necessary, also a good memory. There is one point I must here not omit, and that is that many brigades only take single men; "non-coms" and officers only being allowed to marry. As to age, there are many brigades where twenty-two and forty are the limits for the privates, fifty for the "nom-coms.," and sixty for the officers.

General Equipment.

As to the equipment, there are brigades which have all their sections or units provided with practically the same gear; others where each unit has a double or treble set, one of which is used according to circumstances. The section may have a manual engine, a steamer, and a ladder truck at its disposal, and may turn out with either. Then there are towns where the units are differently equipped, and we find steamer or manual sections called out, as the case may be. In a few extreme cases, where the sections are very strong, they may be equipped with a set of engines and trucks, and the unit, in every case, turns out complete with (say) a manual, a steamer, and a horsed escape. The contrast to this will be found in the small parties of twos or threes I referred to, whose turn-out would only consist of a small horse trolly or an escape. Of course, there are all kinds of combinations, the most important of which allows a section to have one or more independent sub-sections. Though practically belonging to the "unit," the sub-sections work independently in charge of a certain gear. This may be a hose-car, a long ladder, a water, or a smoke helmet, according to circumstances, while the sub-sections may act as outposts—if I may call them so—as a station guard, or simply as specialist parties, which are only called out for particular work.

Stations.

As for the housing of the units or sections, there are the simple street stations for the small parties referred to. In a few cases, I have known two small parties to be under the same roof. The large bodies that back them are generally quartered together in extensive barracks, from which any number of engines and men can be turned out according to the nature of the call. Then there are cities where every section has its own well-built station; others where one or two sections are housed together, according to circumstances, and perhaps as many as half-a-dozen located at head-quarters. If groups are formed, the head-quarters of the group or district perhaps has two sections, while

each of the other stations only has one. The general head-quarters may be the central station of a district at the same time. The actual working of the district head-quarters would, however, then be kept separate from the working of the head-quarters staff. The latter would, perhaps, have some sections ready to send anywhere, besides the trucks, etc., necessary for the officers, the general extra gear, etc., that might be required. It is usual to combine workshops, stores, hose-drying towers, etc., with the head-quarters station, and, in some cases, also with the district centres.

Distribution of Stations.

As to the distribution of the stations, the formation of districts, etc., various systems have been adopted. The most satisfactory results have been obtained where a fully-equipped section (not simply a hose-car or escape-party) can reach any building in the city within seven minutes from the time of the call reaching the station, the seven minutes including for both turn-out and run. Where there are exceptionally large or dangerous risks, this time has had to be shortened to five minutes, and the possibility of an attendance from a second station assured within eight minutes. In dividing up districts, the most satisfactory results were obtained where every house could be reached from the district centre within fifteen minutes from the call. Head-quarters would naturally have a central position in the city. In one or two instances I have known the head-quarters offices to be located in a separate building, which in no way served as a fire-station, but simply as a centre through which all orders and business passed. I do not approve of this arrangement.

Intercommunication between Stations.

The different stations must, of course, be in connection with each other. Excepting in the one city already referred to, the special runner or rider has practically disappeared. The telegraph and telephone have taken their place. Some cities favour Morse telegraphy. It certainly had great advantages over the telephone till within a year or so, as messages could be easily transmitted to several stations with the same effort; but

telephone distributors have now been successfully introduced. Errors are, I believe, less frequent by telegraph than through the telephone, and there is always a record of every message. The most modern forms of telephone communication are, however, more suitable for the fire service than the telegraph, though I should by no means advise the great expense of their introduction where there is a good system of the older means. Head-quarters should be in direct communication with every station, but every station should be able to communicate with its neighbour directly, as well as through the head-quarters office, and there should be a direct wire to its district station if it has one. There should be three routes of communication, so that two would be always ready for use in case of one breaking down. Either head-quarters of the district centres would be in touch with the various auxiliaries referred to, as well as the general telegraph office and the telephone exchange.

Attendance at Fires.

As to the attendance at fires, some cities turn out but one unit to answer the first call if they have no particulars, others always turn out two or three sections, and there are several cities that I know where the district centre would at least send an officer and a few men as well. In one brigade, head-quarters is always either represented by the chief or second officer in the case of a call of this kind. The idea is that it is always better to have too strong a force quickly in attendance than too small a number of men, and that it is most important that the first arrivals should be well handled. Further, if two sections answer a call and one breaks down on the road, there is no chance of there being too great a delay in the arrival of organised help. It should, however, not be forgotten that further calls in the same district to other fires are not unusual, and that the absence of too many engines, on accouut of a first call, is dangerous. In some cities, when a call reaches the firemen one or two of the nearest stations turn out, and if more help is required other sections will be called up individually. In others the reinforcements are not

called up separately, but the fires are divided into three classes—small, medium, and large; and on the message arriving of a more extensive conflagration at a certain point, the sections already know beforehand whether they must attend or not. First calls to certain classes of risks, *e.g.*, to theatres or public offices, may always be considered to be for medium or large fires; and the same message will then simultaneously turn out the stronger body without any further detailed instructions being necessary. In two towns I know of, the fire-call automata are so arranged that the messenger can at once call for the different classes of fire. This, however, is not to be recommended, as a messenger will probably consider the smallest fire to be a gigantic blaze, and will bring out too many engines.

Fire-Extinguishing Appliance.

It is quite impossible for me to here enter into a description of the appliances or working of brigades. Besides requiring some considerable time, I should have to describe a number of institutions individually, and that is not my intention in these pages. I will only point out that where there is a high-pressure water supply, some brigades simply attend with hose-cars, life-saving gear, and ladders; or, instead of the hose-cars, take their manuals, which they practically never use. Others take, and make a point of using the manuals, and have a barrel with them ready to supply the first gallons of water necessary. No time is thus lost in connecting with the nearest hydrant or plug; and in case of a hydrant being out of order, there is always sufficient water at hand until the second hydrant has been found. Some cities have lately introduced chemical engines to take the place of this combination of water barrel and manual engine. A supply of water is carried on the chemical engine. Some cities always have an attendance of steamers, which are, however, only used in urgent cases. In other instances the steamer is at once used in the same way as the manual, and this quite independent of the pressure there is in the water service. Where there is no good water service, manuals or

steamers have, of course, to be sent out, and are either supplied from the low-pressure service or from the natural water-ways or wells. There are yet a large number of cities where the suburbs have no proper water service, and the water barrel comes in very handy here for porterage.

Life Saving and Manœuvring Appliances.

As to life-saving and manœuvring gear, some brigades rely almost entirely on rope ladders, others almost entirely depend on scaling ladders, or telescopic escapes. In one city I know of, great confidence is placed in the jumping-sheet; in another, chutes are much used; and there are a few where wonderful work is done with life-lines. Simply to indicate the diversity with which any one appliance can be treated, made, or handled in the fire service, I would mention that there are quite ten different ways in which a jumping-sheet can be held. Then there is the material of the jumping-sheet to be considered; the size and the shape—whether round, oblong, square, or rectangular; then the means of holding it, the way to fold it, how and where to stow it, and at what distance from the endangered building the sheet is to be held. Last, but not least, come the words of command.

General Working.

As to the working of brigades, I must limit myself to saying that there are, first of all, forces where all possible attention is given to the rapidity of the actual turn out, whilst there are others where the speed at which engines run to the fire is considered to be of primary importance. Other brigades, again, give equal attention to both. There are brigades which work entirely on military lines, each man having certain duties marked out for him beforehand for every possible occasion, and there are others where happy-go-lucky working is preferred. Of course there are combinations in the same way as regards command. I know one chief officer who always arrives at a fire with a staff of adjutants and orderlies, and controls the working of his brigade from a position of vantage at a distance. Another chief of a strong brigade always delights to be in the thick of a fire, perhaps at the branch itself, or on

some gallant life-saving exploit where he no doubt does good work as a fireman, but in no way fulfils the office of a commander. Officers must remember that they are officers, and not rank and file; and this is generally very difficult to those who have advanced from the lowest grade. Superintendents, however smart, must leave acts of bravery to their men, and chief officers, without going to extremes, must always be in a good position where they can superintend everything pertaining to the outbreak in question. Some brigades seem to make a point of it to work quietly, and shouting is absolutely forbidden. All commands are here given by shrill whistles. In some brigades all commands are given by word of mouth, and there is much bawling. In others, commands, besides being bawled, are even repeated on horns, and the noise becomes ridiculous. As a rule, quiet working is a sign of efficiency.

Tactics.

Some brigades work as close as possible to the fire others are satisfied with putting water on or about the fire from a distance. Some attack the fire direct, others only try to protect what surrounds the seat of the flames. In several brigades the orders are to always try and attack by the natural routes of the front door and the staircases. In others, the men always have to attempt some more unnatural entrance, with the aid of ladders —through windows, for instance. Some brigades carefully extinguish a fire, some simply swamp it. I know cases where officers will go so far as to let a roof that is alight burn itself out, simply keeping the surrounding walls, or some attic floor, damp. This prevents unnecessary water damage. The roof will have to be renewed in any case; what need is there to spoil a number of rooms below? Handled by judicious officers, several brigades have been able to boast of never having damaged property unnecessarily. They have, for instance, had the patience to suffocate a cellar fire, instead of putting the whole cellar under water. In certain classes of property the bucket, the mop, and the hand-pump have been far

more effective in minimising actual destruction than the branch and hose. It is one of the easiest signs by which to judge the training and handling of a fire brigade—to see what damage they do. Even an inconsiderate smashing of doors and windows, when there is absolutely no need for it, can be avoided, where every man in the force feels that his first duty is to prevent damage and loss, and his second to extinguish the fire.

Salvage.

Where the brigade includes a salvage division, it is generally stationed at head-quarters; where this division is split up into sections, there would also be a distribution among the district centres: the salvage men are simply part of the force, told off on special duty. Where there are private salvage corps, their stations are generally near the headquarters or district centres of the brigade, from which they receive the notice of the fire. In some cities the salvage corps work quite independently; in others, they work under the chief of the brigade directly they arrive at the fire.

Auxiliaries.

I am afraid I cannot here even touch on the working of other auxiliaries except to say that there are a number of cities where the advantage of firemen having plenty of room to work in is fully recognised, and the police are at once called out with the fire brigade and brought on to the scene in an incredibly short time. There are always vans ready horsed at the police headquarters to take out a squad of men when the fire-call comes, and a certain number of mounted men are also kept ready for this purpose. The value of these measures should not be underrated, especially in cities where rowdyism exists.

In closing I cannot omit to point out that in towns where no independent ambulance corps exists, some of the firemen are often trained to work as ambulance men.

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Publications of the
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SOME AMERICAN OPINIONS

ON

FIRE PREVENTION

BEING

Abstracts from Papers

BY

EDWARD ATKINSON, CHAS. H. BEBB, J. M. CARRERE,
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No. 1.—WHAT IS FIRE PROTECTION?

No. 2.—AMERICAN OPINIONS ON FIRE PREVENTION.

No. 3.—THE PARIS BAZAAR FIRE.

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NOTE.

FREQUENT reference having been made of late to American methods of Fire Prevention, the impression has been given that the United States has already some definite policy on this subject, and that its experts recognise certain principles. As a matter of fact there is as yet no fixed policy as to the best methods for reducing fire losses, and opinions on the subject differ to a very considerable extent. It is with the object of showing to what extent this divergence of ideas exists that the following abstracts from recent American literature have been prepared, and these, no doubt, will also indicate the manner in which various aspects of fire prevention are dealt with in the States. The opinions of recognised authorities have been alone selected for this publication, and no paper has been presented that is not dated within the last five years.

There is naturally a very extensive literature on the subject, but for the present purpose it is deemed sufficient to notice the views of one representative of each of the more important schools of experts. It will be seen that there are advocates of fire prevention on general

lines, of "slow-burning" construction, and of "fire-proofing" respectively; there are those who lay special stress on supervision, and others who hold that the question of fittings, furniture and contents are chiefly to be considered. The main points elaborated in the papers abstracted are alone given, and it would be rash to attempt to summarise here the conflicting opinions expressed therein. One thing, however, seems very clear, and that is, that all the authorities quoted primarily advocate fire *prevention* as distinct from extinction.

The papers from which these abstracts are made have appeared in the *Engineering Magazine* of New York, in the *Journal* of the Franklin Institute, and other American publications.

EDWIN O. SACHS.

London,

January 4th, 1898.

Some American Opinions
ON
Fire Prevention.

I.—FIRE PREVENTION.

IN a lengthy paper on the "Causes of Fire," dated in 1893, Mr. C. J. Hexamer refers to a lecture, delivered in 1884, in which he drew attention to the enormous annual loss by fire in the United States, amounting in 1883 to 100,000,000 dollars; and to an address by Mr. G. E. Wagner at Philadelphia in November, 1892, which gives the annual loss at the same figure, 70,000,000 dollars of this, however, being covered by the insurance companies. But the loss to the nation, as often pointed out, is the same whether the property is insured or not.

The object of Mr. Hexamer's article is to reduce the number of "*preventable*" fires and to write a short fire technology. A long quotation from an article by him in the *Spectator*, an American Journal, points out the importance of the subject, and shows the inability of present buildings to withstand the attacks of fire. The only remedies against the present state of affairs, according to the article quoted, are as follows:—

(1.) The ascertainment of fire-hazards by means of a national bureau.

(2.) Better building-laws.

(3.) Competent inspection and re-inspection.

(4.) The co-operation of the Press in the instruction of the public on these vital matters.

(5.) The inspection of mechanics erecting and heating and lighting paraphernalia by a special municipal department.

(6.) The creation in every city of a special fire coroner who must be a trained expert.

The writer then forcibly argues how in order to lessen the number of serious fires, not so much better means for extinguishing, but better methods of preventing fires are required.

Dealing next with the causes of fires, Mr. Hexamer gives primary attention to the risk of outbreak in dwellings, and after quoting figures, he states that one of the most prolific forms of producing fires is incendiarism due (1) to dishonest policy holders, (2) to motives of revenge or to "pyromania." According to the writer, the majority of fires in dwellings are, however, caused by the heating and lighting apparatus.

Mr. Hexamer thereupon gives a considerable amount of advice as to the prevention of fires in dwellings, which can be summarised as follows:—

(1.) Great care must be exercised with gas fixtures, swing brackets being responsible for a large number of fires. Leakage is also a great danger. Gas flames must always be kept at a safe distance from inflammable substances, and in particular at a 3 ft. distance from the ceiling. Wire cages, such as protect theatre lights, are very useful.

(2.) Petroleum should not be used with a low flash point. Light petroleum products should be considered explosive. A stop should be put to the sale of such products.

(3.) Gasoline stoves are very dangerous and should not be used. The vapour is highly explosive, and gasoline machines should be placed at least 50 ft. from all buildings.

(4.) Electric light when properly installed is safest. Proper insulation is essential.

(5.) Matches, particularly of phosphorus, are frequent causes of fire; true "safety" matches are therefore to be recommended. For lighting gas, however, either electric torches or stationary

electric gas lighters should be used and these can now be obtained at a low price.

(6.) The dangers of smoking are next alluded to, especially the careless throwing away of cigar ends, etc.

Mr. Hexamer, in concluding, insists on the importance of cleanliness generally, untidiness and dirt largely increasing the danger of fire. Workmen engaged in repairs require particular attention. Leaving clothing before the fire over night is exceedingly dangerous, especially, of course, if spirits, benzine, etc., have been used in any cleansing process.

II.—"SLOW-BURNING" CONSTRUCTION.

Dealing with the subject of "The Enormous Annual Loss by Fire," Mr. Edward Atkinson in 1894 stated that in the United States of America the waste of property by fire was increasing year by year in undue proportion to the increase of property at risk. Last year's loss (1893) in the United States had been computed in excess of 150,000,000 dollars. To this sum must be added, says Mr. Atkinson, from 60,000,000 to 70,000,000 dollars for the cost of sustaining insurance companies by which a part of the loss is distributed throughout the community; and for the maintenance of fire departments not less than 25,000,000; making in all nearly 250,000,000 dollars as the penalty of ignorance, stupidity, carelessness, and crime.

Yet, according to this expert, this loss can be remedied in a large degree without the excessive cost of "fire-proof construction." *Slow-burning* methods have been widely extended of late throughout the Western States, and their advantages are recognised by owners and builders alike. The insurance companies of America are also insisting on such *slow-burning* construction before they will consent to undertake the risk of insuring.

The officers of the factory mutual insurance companies

are fully aware, continues Mr. Atkinson (1), that there is no such thing as a "fire-proof" factory building, and (2) that if there were it would cost too much to construct. In a great many European "fire-proof" factories, the combustion of the contents has frequently occasioned complete destruction. Yet the writer argues that the excessive loss must be stopped somehow or adequate insurance will become impossible.

No advocate of mill construction pretends that there are not examples of so-called "fire-proof" construction which will burn more slowly, or which will be destroyed by fire more slowly than any possible construction of wooden timber or plank. But, says the writer, the extra cost of this type of construction may often be saved; as, for instance, wooden floors or posts of suitable size and arrangement similarly resist fire. A properly constructed wooden mill floor will burn slowly enough to give time for the extinction of the fire.

Mr. Atkinson proceeds to show on what principles mills should be constructed, insisting on heavy solid masses of timber exposing the fewest possible corners to a fire, and in such a way as to be most readily reached by water from sprinklers or hose; the separation of floors by incombustible stops, automatic hatchways, etc., to prevent fire from passing from floor to floor; ceilings over hazardous stock guarded by plastering laid on wire lath or some such arrangement, or else protected by a suitable metal like tin. For glazing the windows, fine ribbed glass is advocated.

Mr. Atkinson maintains that the *slow-burning* factories are not only stronger, safer, and better, but also cheaper than any other type of building.

Returning to figures, the writer estimates that in 1893 property equal to 10% on the annual saving in the United States was burned, and that 5% was spent in a "vain and futile effort to save this property."

III.—SUPERVISION AND "SLOW-BURNING" CONSTRUCTION.

In a pamphlet entitled, "Methods of Reducing the Fire Loss," Mr. C. T. Woodbury deals mainly with the question of mills, and after a few general remarks on loss by fire the author comes to the question of supervision. According to this writer the exercise of due precautions beforehand would prevent most fires. To his mind the prevention of fires mainly depends on efficient supervision, which must include inspection of buildings, heed to probable causes of fire, and attention to apparatus.

Electricity serves a useful purpose in fire protection. "The telephone and the city fire-alarm system are considered indispensable wherever possible." But automatic fire-alarms are not so satisfactory as could be wished, and supervision is required to keep them in order.

The use of oil for various purposes is, of course, dangerous and needs great care. Steam pipes, too, must not only be placed away from any combustible materials, but must "not be covered with a non-conducting material which will ignite at the temperature to which they are subjected."

Speaking of construction, Mr. Woodbury remarks that he considers an absolutely "fire-proof" mill would be a practical impossibility, both from its cost and from the unsuitable conditions which would be imposed on the construction. The *slow-burning* method he, however, holds, combines a low initial cost with great resisting powers. "The fundamental principle of such construction," says Mr. Woodbury, "is to mass the material in such a way that there shall not be any concealed spaces about the structure, and that the number of projections of timber which are more easily ignited than flat surfaces shall be reduced as far as possible; that iron portions of the structure shall not be exposed to the heat of any fire in the contents of the building, and, furthermore, that the

isolation of the various portions shall be as complete as is feasible—both as respects one building to another, and the various rooms and storeys of the same building to each other."

After this statement, Mr. Woodbury proceeds to detail the salient features of modern mill construction on the *slow-combustion* method. Great stress is laid on the arrangement of the floors. The cost of this method of building Mr. Woodbury considers to be comparatively small, and the result, he argues, is particularly good. Care must be taken, however, not to pierce the floors with unprotected openings for stairs, etc.

In conclusion, Mr. Woodbury says that conscientious supervision, combined with *slow-burning* construction, are practical measures which have already been widely carried into effect for the purpose of reducing the fire loss. The result, this writer says, has not only been good, but it has been proved to American commercial men that it is not only possible to prevent a fire, but also cheaper to prevent it than to sustain a loss.

IV.—"FIRE-PROOF" CONSTRUCTION.

As an example of an American opinion on the advantages and weaknesses of a so-called "fire-proof" building, the following extract is presented from an article on "Fire Losses in Fire-Proof Buildings," written by Mr. Charles H. Bebb, in 1893.

This article commences by stating "that the Science of Building Construction has undergone considerable reformation in America during recent years, through the introduction of the skeleton construction system, and that the paramount reason for the widespread interest which is beginning to be felt in regard to methods of building, is to be found in the enormous fire losses that have occurred throughout the country, not alone in buildings of ordinary construction, but in those which were presumed to be fire-proof."

New principles bearing upon the "fire-proofing" of buildings are being continually laid down by able writers, and "the demand was no sooner created for a science of 'fire-proofing' than it was immediately met by the formation of companies for the very purpose of supplying it." This new industry has developed "year by year, until at the present moment there is not a first-class architect or engineer in the country who will deny that an absolutely 'fire-proof' building can be built, and at a reasonable cost. Yet fires of the most disastrous character are constantly occurring in buildings advertised by their owners as 'fire-proof.' It is not surprising, therefore, that a large element, probably a vast majority, of the entire community doubt the possibility of constructing an absolutely 'fire-proof' building."

According to Mr. Bebb, "every fire which has occurred in so-called 'fire-proof' buildings has been due to the indiscriminate use of combustible material in construction."

The main topic of this article, which is excellently illustrated, is the following account of the burning of the "Chicago Athletic Club Building," which was intended to be perfectly "fire-proof." This Club building, at the time of the fire, was rapidly nearing completion. The fire broke out on the fourth floor and assumed such proportions that it appeared that the building was certainly doomed.

A visit to the scene and an examination of each separate floor demonstrated the fact that almost every particle of combustible material, not excepting the window frames bricked in the openings, was consumed. Such was the intensity of the heat that the surface of the fire-proofing material and the exposed face of the brick in some places on the fourth and fifth floors became fused, and the molten glass from skylights in the courts on either side of the building ran down the walls. The chief of the Fire Department was credited with saying that he never saw a hotter fire than in this

very modern "fire-proof" building. The facade above the third floor was entirely destroyed. Interior decorations, iron piping and electric wires suffered in the same way.

In its structural entirety, however, the Athletic Club building remained apparently intact. "The tile arches of porous terra-cotta, set according to the very latest adoption in construction—namely, the 'end construction'—were practically uninjured by the combined action of intense heat and tons of cold water; not one arch had fallen, and in some tests made on the worst-looking arches, a sustaining capacity of 450 pounds per square foot was recorded without there being any sign of rupture. The partitions also, of the same material, were practically intact and as originally built, except that every door, door-frame, and casing, and all wainscotting and wood-work entirely disappeared, and that the plastering was completely stripped off, leaving the tile bare. The wood floors were entirely consumed, and in many places the strips bedded in the concrete to receive the floor were burned completely through."

Mr. Bebb then continues by explaining how in regard to the column protection which in itself must be considered of paramount importance, a piece of unmitigated folly most inconceivable in its carelessness was exposed. His words are as follows :—

"Almost any scheme that will keep the size of the uprights down to a minimum is adopted. Miles of vertical piping for soil, waste, supply, etc., however, enter into the construction of modern buildings, and are run from basement to attic alongside of the most convenient column. A plumber's helper, with hammer and chisel, is sent to cut away the tile arch at the base of the said column at each floor. The hole is made to permit the passing through and screwing up of pipes with little difficulty to the plumber. All buildings, nowadays, are a 'rush job,' and there is no time to fill in and patch these holes with concrete, and even if done,

the chances are that the plumber will begin turning again on one or other of the pipes before the concrete has become set, and in consequence, it falls out. The piping completed, the fire-proofer starts to get in his work. The finished plaster line from which the tile is to be kept back three-quarters of an inch, is generally his guide, and is rarely more than two inches from the extreme edges of the iron column. Then is the ingenuity of the mason called forth, and it takes a mechanic of no mean skill to accomplish the work within the requirements; with one-inch slabs and plenty of mortar to make them 'stick,' he makes a fair job on two sides of the column; then grooves are cut in the tiles, often reducing the material one-fourth in order to cover a pipe that projects 'a little too far'; if, however, the mason is 'rushed,' he does as well as he can with chips and mortar, plasters the exposed pipe with mortar, and with a few nails and some cheap flexible wire, a double fact is accomplished. The column is 'fire-proofed' ready for the plasterer, but in reality a continuous flue, 150 feet high perhaps, for the possible passage of heat and flame, is created, with the bare surface of the iron column as one side of the said flue, and a thin wall of uneven thickness on the other."

Concluding, the writer remarks that "laws governing 'fire-proofing' do not begin to be efficient, and will not be until the possibility—to owner and architect alike—of using unnecessary combustible materials is absolutely precluded, the term 'unnecessary' to be practically and specifically defined."

V.—DANGEROUS FITTINGS.

Various circumstances of modern life, have, especially in New York, tended to the erection of buildings of an abnormal height. Mr. Edward Atkinson in another article on "Fire Risks on Tall Office Buildings," deprecates the use of such structures. "These tall buildings,"

he says, "are virtually steel towers veneered with 'fire-resisting' material, but filled with combustible materials."

He shows how well-constructed brick and iron buildings in which even the iron beams and posts are comparatively well-protected from the direct exposure to heat are turned into tinder boxes:

(1.) "By the construction of combustible wooden dados on the walls, which are wholly out of place."

(2.) "By sheathing the walls with very combustible fine wood fastened solidly against the brick-work."

(3.) "By heavy combustible wooden mouldings or frames around the doorways, in which wooden doors are placed"

(4.) "By setting up extensive light wood partitions of pine and glass of the most combustible kind, throughout many parts of the building."

(5.) "By enclosing open stairways built of wood in wooden partitions."

(6.) "By conducting elevator wells into an open space in the roof."

(7.) "By the building being thus supplied with light wood in sufficient measure to tear any building to pieces by expansion when the wood is fully ignited and this woodwork is generally furnished with the most combustible turpentine varnishes."

According to Mr. Atkinson, the true question of safety does not consist wholly either in limiting the height or the number of stories, or the width and length of floor areas. The judgment exhibited in the main construction is often lacking in dealing with the finishing, and the combustible material used in the finish frequently nullifies the safety of good and sound external construction.

As to the general question of construction, Mr. Atkinson says, that "we have not yet mastered the best methods of using brick, fire-clay, tile, cement, and mortar in the interests of fire-resistance." He concludes as follows:—

"We are groping our way to find out how to use our huge abundance of the best materials, and to adapt them to the climate and conditions of this country. One can, however, even now conceive of a building of tile construction—finished inside with wood pulp rendered incombustible, or with terra-cotta or other form of clay—walled within with plaster-board, and covered on the outside of the roof with indurated fibre tiles—light, strong, and impervious to water. The elements exist even now, which, when combined, may render it possible to construct a building at low cost, which will be sufficiently 'fire-proof' to resist the combustion of its contents. This may be considered a somewhat visionary hypothesis, but such a building is nevertheless within the sight of anyone who attempts a forecast in the light of the fires of the past."

VI.—DANGEROUS INSTALLATIONS.

Mr. John M. Carrere, in a paper on "Interior Fire-Proof Construction," says, that "while there is a great variety of excellent materials for fire-proofing the constructional portions of the building, no means have been devised for 'finishing' a building with non-combustible material." Mr. Carrere then continues by saying, that "the materials now in the market for this purpose fail to meet the requirements, because they are neither 'fire-proof,' nor 'slow-burning.'" He suggests as a substitute, "stamped metal filled with plaster of Paris," and thinks that "the best that can be done is to reduce the amount of inflammable material to a minimum." He also advises architects "to construct in such a manner as to allow of no voids."

"The floors," according to this authority, "if properly constructed and made 'fire-proof,' will prevent the fire from extending directly from one storey to another, and laterally, if the partitions are properly constructed and made 'fire-proof.' Further, if the hall-doors and jambs,

and connecting-doors and jambs are also made of 'fire-proof' materials, the chances will be still lessened," and each room can be considered isolated. The use of modern patent wall-plasters will also retard the flames.

The author then sets forth his opinions in regard to construction, laying particular emphasis on the planning of the building and on the various installations. He believes that one of the principal dangers could be met by providing buildings with well-arranged installations, and not forgetting them when designing a building.

"The great evil of construction," he thinks, "lies in the provision of combustible ducts, by which means we get so many channels of connection from cellar to roof." In a large percentage of buildings these ducts are anything but fire-proof, while floors, grounds, furring, etc., are allowed to run across them and into them.

Mr. Carrere argues that, "if when a building is first planned it is so arranged that the ceilings of all passages can be dropped, thereby obtaining a horizontal space between the floors and ceilings of the landings on every floor, which can be lined and made entirely 'fireproof,' and all of the horizontal portion of the mechanical plant can be placed in these ducts. This process is economical both as to construction and as to installation, and every particle of the plant is then always within reach for repairs or changes. And at the ends of these horizontal ducts, vertical ducts, solidly built of fireproof materials—hollow blocks or bricks —can then be provided, running from cellar to roof, furnishing the best means of installation for the vertical plant, and connected at each floor with the horizontal ducts."

At present, Mr. Carrere holds, we pay little or no attention to the arrangement of the various installations from the fireman's point of view, and he considers this carelessness to be a source of considerable danger.

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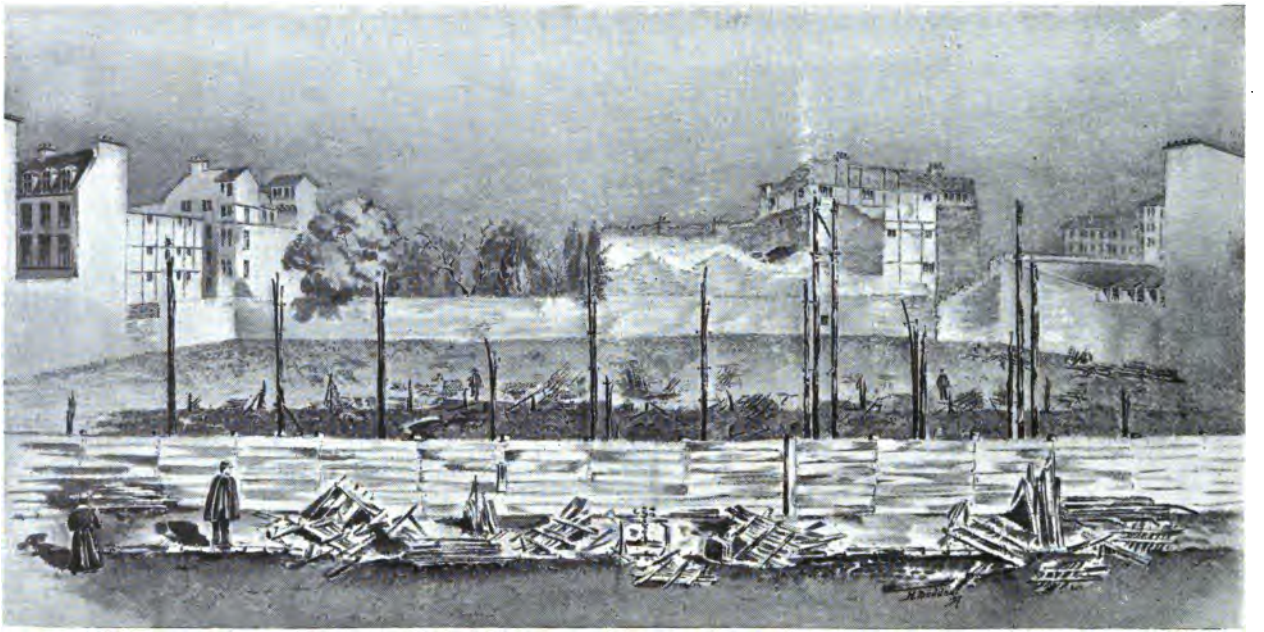

PARIS BAZAAR FIRE, MAY 4, 1897.
VIEW OF BUILDING AFTER FIRE.

Publications of the
BRITISH FIRE PREVENTION COMMITTEE.—No. 3.

THE PARIS CHARITY BAZAAR FIRE

BY

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"FIRES AND PUBLIC ENTERTAINMENTS," ETC.

A Paper

PREPARED FOR THE
ARCHITECTURAL ASSOCIATION,
SECOND ORDINARY MEETING, SESSION 1897–98.

Mr. HAMPDEN W. PRATT, F.R.I.B.A., President, in the Chair.

With Comments by

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NOTE.

THE PARIS CHARITY BAZAAR FIRE of May 4th was the subject of a discussion at the Architectural Association, in which a number of members and visitors interested in the question of preventative measures at public entertainments participated. Though the paper which led to the discussion was prepared for the architectural profession, and not written from a more general point of view, the unanimous expression of opinion on that occasion in favour of judicious preventative measures, and the attention accorded to the subject by the general public as represented by the Press, has induced me to have the paper and the discussion thereon printed *in extenso* for this series. It is seldom that the different interests are so widely represented as was the case at that meeting. Besides the Vice-Chairman of the Theatres Committee of the London County Council, there were the Superintending Architect to the latter body, Mr. Thomas Blashill, and the second officer of the Council's Fire Brigade, Mr. Gamble. Major Fox, of the Salvage Corps, Captain Dyson, of a provincial Fire Brigade, and a constant attendant at our entertainments like Mr. William Archer, all participated in the discussion, besides members of particular experience as Mr. Lovegrove and Mr. Max Clarke. This unanimity where so many interests are represented is an excellent omen for the work of the British Fire Prevention Committee, and it is only to be hoped that the Paris Bazaar Fire will teach us henceforth not to neglect the safety of such gatherings or such premises as are to-day outside the control of our public authorities.

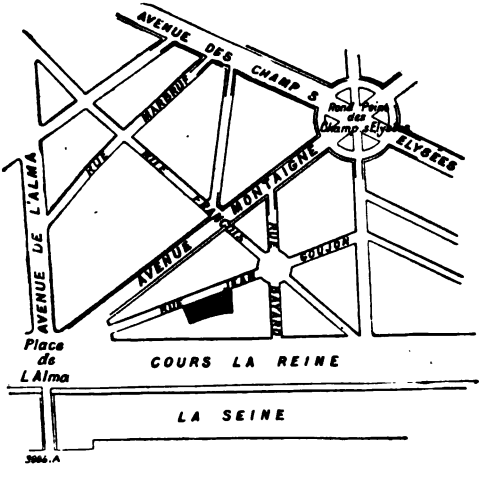
EDWIN O. SACHS.

London,
November 10th, 1897.

THE
Paris Charity Bazaar Fire.

INTRODUCTION.

THE evening papers of Tuesday, May 4th, informed us in their "Extra Special" editions that a terrible fire had that afternoon occurred at a Paris Bazaar, and that many lives had been lost. The next morning we read all manner of descriptions of the conflagration at the so-called Charity Bazaar, more or less accurate, more or less sensational, according to the standing of the journals in which the reports were published, and the facilities enjoyed by the various correspondents. At every breakfast table throughout the country that Wednesday, people no doubt expressed their horror. The fearful loss of life was the sole topic of May 5th. On Thursday we had yet fuller particulars; all London still talked about the calamity. But then suddenly when Friday came, the Paris Bazaar Fire was practi-

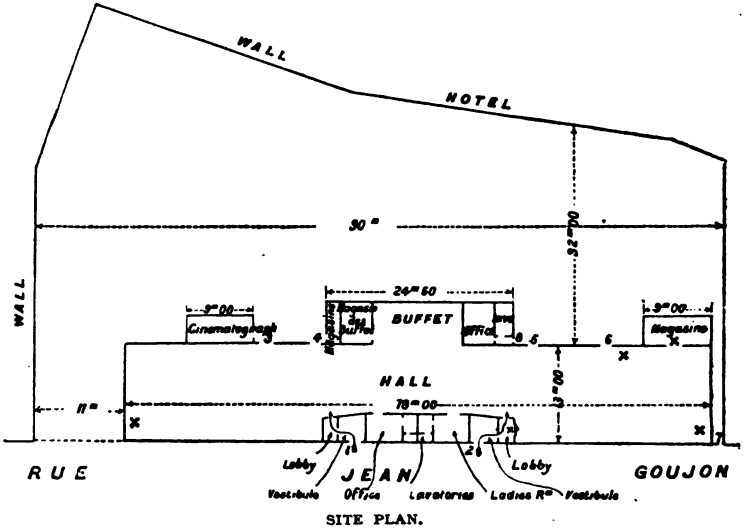


SITUATION.

cally forgotten. There may have been some slight flickering interest on the occasion of the Lord Mayor's visit to Paris to attend the funeral, and at the death of the Duc D'Aumale from the shock at hearing the news, but that was all. The questions which were asked in the House of Commons in connection with the fire, and the few words that were spoken at the London County Council, practically passed unheard. Nobody cared about the trial that took place at Paris in August. Public interest in such matters is short-lived indeed. And yet the number of deaths at the Paris Bazaar Fire was about 124, and many of those who succumbed were personally known in London Society, and a great number of the names of the deceased had also often been heard of by the British public. Paris is no small and far-distant town. We are within easy travelling distance of the French capital. In forty-eight hours, say three days at the utmost, the fire was forgotten, exactly as was the case with the Vienna "Ring" Theatre Fire of 1881, with its 450 fatalities; with the Opera Comique Fire in 1887, with a death-roll of 115, and other great catastrophes. Why, even when the Exeter Theatre was burnt down in 1887, and 160 lives were lost, not many miles from this metropolis, the country forgot all about it within a week. And remember, the Exeter and Paris Opera Comique Fires occurred in the same year, and were followed by a serious fire at Oporto with the loss of another 100 lives.

Let me recall some of the facts of the Paris Bazaar Fire, and I shall be doing so before the members of the profession with whom to a great extent will rest the responsibility of future catastrophes of this description. For no profession is so closely associated with the erection of our dwellings, our public halls, our places of public entertainment, and all those many kinds of structures, not forgetting places of worship, amid which we spend our lives. Now one of the greatest features of the 19th century has been the continual

effort to prolong life, and you are, I am sure, doing much in this important movement by seeing that your clients live in sanitary surroundings, and thus avoiding those terrible scourges of fever and other maladies which not so long ago decimated many communities. I need not here say how much the medical profession is doing in the interests of the prolongation of life, or how, in fact, nearly every profession, and even nearly every trade directly or indirectly, assists in adding to the longevity of the present and coming generations. Our Public



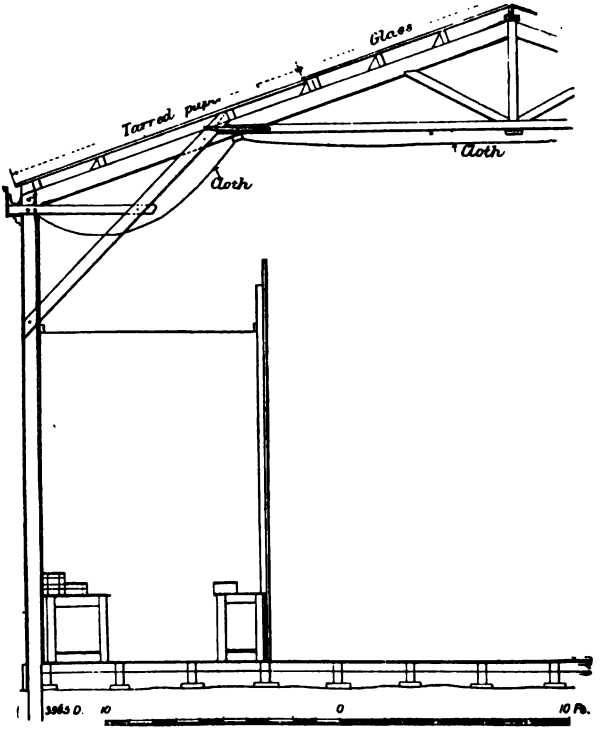
SITE PLAN.

Authorities, not forgetting the police, are much occupied in the same manner, for they protect our lives in numerous directions. Yet neither these authorities, nor architects, nor any other profession for the matter of that, has so far done very much for the safety ot life from fire.

Now, it may be somewhat aside from the question of the Paris catastrophe, but it may be of interest to know that Great Britain alone has an approximate total loss of property by fire of seven million pounds

per annum, and this is an absolute loss of the nation's wealth, and the wealth of the communities concerned. The annual loss of life is very heavy, and the number injured exceedingly large. Now, quite apart from sentimental reasons, is it not very curious that in such a practical country as ours, we should allow this constant drain on life and property, and what is more, allow it to a far greater extent than is the case in several other countries which are by no means so business-like as we are, and are certainly not doing so much to prolong life as we do in this country? The object of putting this paper before you, and not, say, before some body of economists, some gathering of statisticians, or some association of public officials, is that to my mind, the architect, and the surveyor, often assisted by the civil engineer, can do far more in minimising our loss of life, and thus add to the longevity of our race, than any law or regulation can do for us. You know it is an old saying that "Laws are made to be broken," and I am sure many of you pride yourselves on your "'cuteness" of having found some outlet, some make-shift, or excuse for avoiding some of the few requirements laid down by the Public Authorities in this matter of safety from fire. We all know how proud the architect is when, say, he has a factory case, with the lives of hundreds of employees involved, and he can go to his client and say: "Sir, I have saved you that emergency staircase which figured so prominently on your schedule," and mentally, perhaps, thinks of the extra twenty-five guineas he will get for his successful negotiation. We know how proud the theatre architect is, when, fighting against some long list of requisitions, he can point out to the lessee: "I have saved you that exit; I have saved you that reduction of seats"; and maybe he also thinks of the extra fee, but certainly he never—any more than the architect with the factory case—gives a thought to the lives of those who enter the building on which he has advised. Don't let me be misunderstood;

every architect not only has the right but the duty to express his opinion on the requirements or requisition with which the Public Authority wishes his client to comply. We know full well that Public Authorities with the very best intentions, sometimes have ignorant officials, more especially in their junior ranks. We also



SECTION SHOWING ROOF, VELUM AND STALLS.

know the ambitious young official who prides himself on the long list of requisitions he has made at Mr. Tom Jones' Theatre, and on having discovered the many faults of that playhouse all by himself. I am not trying to dissuade any architect from the fair, open-minded and technical criticism of any list of

requisitions. By no means; but I consider it reprehensible, nay, wicked, to oppose every regulation for the safety of life and property, for the mere sake of opposition, and for the mere sake of pleasing one's client. Study the requisitions conscientiously, and if you find exaggerated demands on the part of the Authorities—mistakes, faddism—certainly try your best to get your client out of spending unnecessary money. If the Authorities know you treat matters seriously and fairly, you are sure to have far more consideration given to your arguments than if the reverse is the case. But don't oppose for the sake of mere opposition, or because it is the fashion to try to "best" the authorities. Don't say that this opposition is at the instance of the client. The client very seldom wishes to oppose the legitimate requirements of the authorities, or at least not until the architect has told him of all the savings he may effect by avoiding the regulations and requirements. Every factory owner knows what a fire would mean for his business, no matter how well insured he might be; every theatre owner and manager knows his responsibility well, and knows that the audience of to-day wishes to feel safe when taking its amusement. The opposition of 1897 to my mind emanates to a great extent from the architect. And I will go farther and say that it emanates not only from an inherent love for opposition to any so-called Building Act, but also from the architect's desire to show his client what he is worth. Let us leave that kind of thing to the bad architect, who has no reputation to lose. Follow the lead of men who, though keenly asserting the rights of their clients, always try to give their places of entertainment good straightforward planning, and in full accord with modern requirements. Otherwise measures will have to be adopted to make architects personally responsible for their buildings, as is the case in other countries, and I am sure you would not like that.

THE BAZAAR BUILDING AND THE FIRE

After these preliminary remarks, let me give a few facts about the Paris Bazaar Fire, and the construction of the building which was the scene of the holocaust.

Firstly, it should be noticed that the scene of the catastrophe was in a temporary structure. After the fearful loss of life in this building whilst used for bazaar purposes, and hence having its floor space in nowise blocked by seats or barriers, it would be well to

VIEW OF INTERIOR BEFORE FIRE.

remember that the premises had actually been previously used for theatrical purposes. The building had been equipped with a stage, with a raking floor, with fixed seats, and all paraphernalia and illuminants for dramatic performances, and such entertainments had actually been given on the premises.

Both the stage and seats had only been removed to enable the structure to be adapted for the organisation of a Charity Bazaar. Much has been said as to the premises being a place of public resort. It is, however

difficult to decide whether the entertainment was a public one in the sense understood in this country; for though it appears that the visitors attended by invitation only, and not by ticket purchasable at the doors, custom seems to have required a "voluntary" payment to be made on entry. In most countries any payment at the doors, even for a programme, invests the entertainment with a public character in the eyes of the law.

Next, it should be noted that the site of the building was in the Rue Jean Goujon, close to Rond Point of the Champs-Elysées on the one hand, and to the Cours de la Reine on the other, and hence it was situated in a much frequented part of the city. It was not hidden away in some back garden or placed in some outlying suburb. Roughly speaking, the ground has a frontage of over 90 metres, or nearly 300 feet. Its depth averages 45 metres or 150 feet. It is within a few hundred yards of a small police station in the Palais de l'Industrie, which also has a permanent fire watch from the "Regiment des Sapeurs Pompiers." An important station of the latter body is not far distant. The Rue Jean Goujon, as will be seen from the site plan, ends at the Place de l'Alma, and there is an abundant water supply from the River Seine for any number of steam fire engines; but as far as the water service in the roads is concerned I understand it was not the most satisfactory. The site can in an emergency be approached from the back by the fire brigade passing through the houses facing the river.

Speaking of the structure, nearly 80 metres of the frontage was taken up by the temporary building, the average depth of which was 13 metres, and there were several small additions to the back, namely a refreshment room, a large store room used at the time of the catastrophe as a cloak room, and the fatal cinematographe room. The last-named annexe, which will be seen from the ground plan, was not, as far as the plan shows, in direct communication with the main building

for entry and exit, the approach being from outside and the visitors passing through door No. 3. The main building covered about a third of the superficial area of the site, while two-thirds, having an average depth of 32 metres, had not been built on. The site was enclosed on the back and two sides by walls of various heights from 15 feet upwards, and by the party walls of some adjoining houses. One of these blocks, the Hotel du Palais, has windows overlooking the ground.

The plan of the building showed a long gallery constructed of a series of framed trusses, the whole of the work being in timber. All the walls were match-lined on both sides. The roof was partly covered with tarred felt and partly with glass. The total cost of the structure was about twelve thousand francs, or about £480, of which sum nearly half was spent on the materials employed. The contractor carried out the work with particular regard to economy, and hence, perhaps, the lightness of the structure. So far as the contractor was concerned, the building appears to have been considered of a private character, little or no supervision apparently being exercised by any of the local authorities. The principal entry was through two doors, placed centrally, No. 1 and No. 2, and the visitors passed through a small vestibule and inner lobby in each case. There were four additional exits at the back, Nos. 3, 4, 5 and 6, of which No. 3 alone seems to have been well known, owing to its forming the approach to the cinematographe annexe already referred to. There was another exit, No. 7, used for service purposes, with which only the management and the stall-holders were acquainted, and there was also a small door, No. 8, from the refreshment annexe, into the open. In the front of the building there were several windows to the office, the ladies' room, etc.

On both sides of the gallery, there were rows of stalls, and the construction of these, together with the section of the building, is shown in the diagram which I have had specially prepared from the working drawings

in the hands of the contractor. The frontages of these stalls were faced with scenery, whilst the top of the hall was closed in by a velum of canvas. The decorations were elaborate, and, I must again add, particularly inflammable, while the articles for sale on the stalls were of course of a similarly dangerous character. Perhaps I should also mention that the decorations to the stalls were old, worn, and very dry. The floor was of wood, resting on timber sleepers. On the exterior the only attempt at decoration had been in the central feature.

There is no doubt that the fire originated in the cinematographe annexe, and that the actual cause was due to carelessness in using the special lamp employed. But I will not go into detail on the point of the actual cause of the outbreak, as this would teach us little and only afford another instance of the criminal reck lessness with which mineral oils and explosives are handled. It appears that the flames broke through to the gallery at once, and were drawn immediately across the hall to entrance No. 1. It will be seen from the drawings that the glass at the top of the building must have been broken almost immediately, through the enormous velum becoming a sheet of fire. Further, it is evident that the velum must have broken away from the points at which it was suspended, falling on those beneath. The tar on the roof also dropped in a molten or burning state. The plan will explain how those farthest away from the centre on the cinematographe side of the building, must have been cut off directly the flames took a hold of the doors No. 3 and No. 1. It was further natural that there should then be a general stampede towards entrance No. 2, and to that part of the hall farthest from the cinematographe. The extra doors, No. 5 and No. 6, were apparently so little known that they were not used, and it appears that many of the visitors were caught at the entrance to the store annexe, which I have already stated was then serving as a cloak-room, and, hence, well known to many of the

ladies, who, in the excitement of the moment must have associated it with an exit. In this annexe most of the bodies were found, the other points at which deaths occurred being marked with an "X" on the site plan. The diagram shows that some of these positions are very near the doors Nos. 6, 7 and 2.

It is not my purpose to discuss the plan in detail, but there is one thing certain, and that is, that at first sight the number of exits, eight in all, would appear sufficient for a substantially-built structure which has its floor on ground level. I would even go so far as to say that there are not many galleries of the same dimensions, standing under the control of a public authority in this country, that have a larger number of exits; but here it should not be forgotten that in the planning of places of public entertainment, precautions are not based on the assumption that flames will spread with such rapidity as was the case among the decorations, fittings and general appliances of this fatal structure. In a well-planned theatre of the most modern type there is always the supposition that some four or five minutes' time will be given to the audience to leave their seats in the auditorium proper. There is one unfortunate feature of the planning of the Paris Bazaar I cannot, however, help noticing, and that is the manner in which the lobbies to entrances Nos. 1 and 2 were set out with the view of excluding draughts. I am unable to get reliable information as to whether the wings to these doors swung outwards. As to the doors Nos. 3, 4, 5, 6, however, I know that they opened inwards and that one of them was blocked or bolted at the time of the catastrophe.

Looking at the plan of the building, its construction and contents, and considering well all the defects that such a structure must contain, I would yet point out that the extent of this calamity was due in a great measure to the fact that the majority of those present were ladies whose clothes must have undoubtedly caught fire immediately the lengths of canvas velum and

burning tar fell. I have on a former occasion argued that English women are far more fearless in facing danger than their sisters of other nations owing to their constant association with the various forms of sport practised in this country, and much has unfortunately been said to the effect that a panic of such dimensions would be impossible in Great Britain. I scarcely, however, think that my argument holds good in a case like the recent catastrophe at Paris, for the scene must have immediately been of such a terrible nature that even those whose profession makes them acquainted with the terrors of fire, would, in all probability, have lost their presence of mind. It would not be doing justice to our French neighbours if I were not to say that, in spite of the severity of the panic, heroic deeds were done and death itself faced in doing gallant acts, acts which English men and women would have been proud to have been associated with.

To recapitulate the main features of this catastrophe, let me repeat that the building had its floor practically on pavement level, and stood on its own ground, with its front on a broad public thoroughfare. There was vacant land at the back, a broad passage on the one side, and a narrow one on the other. There were eight exits leading direct into the open, with an aggregate width of some forty feet. The visitors were mostly ladies dressed in Spring apparel; the spread of the flames was exceedingly rapid, and their garments became ignited almost immediately. The general aspect of the fire was particularly dangerous. There is no doubt that many of the visitors practically died where they stood at the time of the outbreak, being enveloped almost immediately in the burning canvas which fell from above. Of the others who succumbed, many were entrapped either by being cut off from the exit, by finding these blocked when they reached them, or by not knowing their exact position. Of those who escaped by the principal exits, a large number were injured by the crush at the doors.

Though the police and the fire brigade were within easy call, even the instantaneous arrival of a large force on the spot could scarcely have lessened the death-roll, owing to the rapid spread of the fire, and the extent of the panic. I have not heard that any watchman or fireman was stationed in the building, but even had this been the case, it is not in the least likely that his efforts would have had any appreciable effect. The great heat from the fire appears to have prevented those who reached the land at the back from utilising this space as a refuge. A window of the Hotel du Palais was used by many escaping to the rear of the building, as the broad passage opening into the Rue Jean Goujon was apparently overlooked. A number of the visitors were, however, either killed or badly injured in the crush in their efforts to reach this improvised means of escape. As to the extent of the destruction, a good idea can be formed from the copy of a sketch made on the spot. In closing these remarks on the actual fire and the fatal building, let me again state that no less than 124 lives were lost, and of the injured many even to-day are in a serious condition or are practically human wrecks owing to the nervous shock which they sustained.

FIRE PREVENTION OF TO-DAY.

Now, if I may be allowed to classify, the Paris Charity Bazaar was a semi-public Entertainment, held in a provisional building. As you know, our entertainments are either of a private, a semi-public, or a public character, whilst the buildings utilised are either permanent structures specially erected for a specific purpose, permanent structures temporarily adapted for some purpose, or they are provisional buildings.

SAFETY AT PUBLIC ENTERTAINMENTS.—As far as public entertainments in buildings specially erected for the purpose are concerned, nearly every country

has already inaugurated some policy for preventing catastrophes. I here refer to the theatre, the music hall, the assembly room, &c. Europe has, in fact, every kind of legislation conceivable for the protection of the public in this class of structure. There has been hysterical panic legislation, ponderous regulations in which every detail is defined by law, also Codes which leave practically everything at the discretion of an executive of experts, and regulations which are merely so by name, and are a farce because they cannot be put into force. There is no uniformity in the preventative legislation of the world, even in its elementary principles. If we study the regulations of different countries consecutively with an idea of discovering what is really necessary, the result is most confusing. But I am not going into detail: neither shall I quote clauses. Yet for all that, I will say broadly that some countries seem to consider that good construction is the essence of safety, whilst clear planning, watching and inspection are forgotten. Other countries give all attention to endless regular inspection, and omit the watching; others, again, require inspection only; whilst others, perhaps, insist on good planning, construction, and ample inspection, but disregard the watching. It is time for some representative body of experts to decide what they consider necessary in the interests of the public. I am not going to raise the many questions as to the proper executive for locally determining or enforcing the requirements, nor shall I enter into the merits of individual regulations. I will simply call attention to the want of uniformity in the main and elementary principles for obtaining safety where we have to deal with buildings erected for specific purposes and where specific forms of entertainment are given.

Personally, I hold that for a theatre or music hall, clear planning is of greater importance to the audience than clever forms of construction, or the employment of

materials having considerable power of fire-resistance; and further, I contend that in such buildings the regular attendance of fire-watches day and night, and more especially during performances, is more essential than any amount of regular or even surprise inspection. But this is only a personal opinion. There are no definite conclusions as yet arrived at by any body of experts representing the conflicting interests which play such a prominent rôle where our public entertainments are concerned.

In expressing my opinion on the matter, I should, perhaps, say at once that I consider it the duty of the authorities to attend to the protection of life in the first place, and to the protection of property in the second. As we all know how easily a panic occurs without any fire, and how dangerous the rush of a frightened audience can be, the clear exit of ample dimensions and most direct route will be the greatest safeguard against loss of life, and perfect symmetry of plan of very great value. The prevention of a cause for panic is best guarded against by the constant presence of experienced and responsible firemen, who will, on the one side, recognise the possibilities of danger in time to prevent a fire, and, on the other, be able to act smartly in case of an outbreak. I do not wish to disparage good construction, or regular and surprise inspections; but I consider the most careful regulations as to construction and materials are of little practical value, so far as the safety of the audience is concerned, if, at the same time, the planning is not straightforward, and responsible firemen are not regularly in attendance. To take an extreme case, wood stairs will take the audience quite as quickly into the open as stone ones, and stone stairs with many winders and a complicated plan will be far more dangerous than wooden ones of straight flights of, say, fourteen steps each. Don't let me be misunderstood; of course good construction and fire-resisting materials lessen the risk

of an outbreak of fire, and I shall always advocate such construction and materials. But I have inspected many theatres, built of slow combustion materials, and yet have found them dangerous in the extreme through bad planning; and I wish to point out that a building erected entirely of fire-resisting materials is not necessarily the safest. It is also on account of my acquaintance with the fact that many important cities, though equipped with modern regulations for the erection of theatres, have no powers to enforce the presence of an official fire-watch during the performances, that I am anxious to lay stress on the necessity of watching, and not only of inspecting the theatre and music-hall of to-day.

PREVENTATIVE MEANS AT SEMI-PUBLIC AND PRIVATE FUNCTIONS.—All that I have said so far refers to the permanent building erected for a specific public entertainment. Even here, with given facts, I have to tender personal opinion, because we have not yet arrived at definite conclusions on the subject. What, may I ask, is the state of affairs as to semi-public and private entertainments in buildings, halls or rooms only temporarily utilised for gatherings of this description? So far nothing scarcely has been essayed, let alone decided. Legislation on the subject in this country is as non-existent as it is on the continent. Why, we have not even as yet any practical definition as to what a private or a semi-private entertainment is. The whole subject is so delicate a one that even such despotic Police administrations as those of Prussia and Russia have not yet felt their way. Where do the privileges of private entertainment cease? and when does an entertainment assume a public character, not only as such, but more especially in respect to public safety? Cannot every man do exactly what he pleases on his own property so far as entertainment is concerned, and as long as the general public is not admitted by payment? But is not a Foreign Office Reception on

Her Majesty's Birthday to all intents and purposes, a public entertainment, and similarly, the ladies' political drawing-room meeting in Park Lane? Is not a bazaar, held in a tent, say, at the Botanical Gardens, and to which only members of the Society with their friends are admitted, a public entertainment? How many bazaars, let me ask, are held without payment for admission on private property, which are essentially of a public character? Think of the many meetings, so-called private theatricals, subscription balls and other fêtes! How is classification to be attempted? How are we to define our entertainments? But here a suggestion: Is it necessary to classify at all? Is it essential to make limitations as to the different classes of our entertainments? I think not. Whilst most of our legislators at home and abroad are trying to define our entertainments and then to frame certain requirements for the safety of the public, why not let the character of the entertainment take care of itself. Let us look on every room over a given size as a place in which we may or may not congregate, with or without payment, to dance, to sing, as the case may be. Let the superficial area of any given room and its position alone govern our requirements for safety; not the fact that it is a private dwelling-house, a saloon at an inn, a school-room, or a Board room.

If the Building Act of to-day defines the thickness of a party wall and its height above the roof, quite independent of the fact of a man giving a party, or lending his house for a drawing-room meeting, having a chemical laboratory in the place, holding dancing classes, or carrying on a School, why should there not be such planning compulsory as to prevent any room over a given size, be it a ball-room or a studio, being used without risk to life? Why should not every large drawing-room on the first floor have sufficient exit and staircase accommodation to deal with the maximum

number of people who press into that drawing-room? and let the same hold good for every class of structure, if a public house, a school-room, or a chapel. Do we not all know the bazaars held in houses kindly lent by charitable owners? I have a house in mind in Carlton Terrace, where the first-floor drawing-rooms are at times simply packed, and the staircases so crowded that it takes a full half-hour to get from one floor to another. The functions are essentially of a semi-public character, and as dangerous as I can remember. You all know the entertainment in the parish school-room, given ostensibly by the schoolmaster to the friends of the pupils. Well, again, don't let us bother too much as to the exact purpose of any gathering, but let us build our larger rooms so as to allow for assemblies of any description, with safe and speedy exit in case of need.

But now, another point. How are we to assure ourselves that even if any one room or hall fulfils the ordinary requirements of safety as far as plan and construction are concerned, that the variations in the interior arrangement, in the decorations, etc., do not more than counteract what the architect has done. Of course, a building, a room, or a temporary structure should be used for what it is designed, and for no other purpose. But in reality we must consider the possible purposes to which a room may be put, in fact, the dangers of any decoration or paraphernalia necessary for the fulfilment of various objects must be considered at the time of construction. A hall which is used as a ballroom, and which is perfectly safe as such, may be a veritable mouse-trap when used for theatrical entertainments. A hall designed only for banquets, public dinners, etc., may become dangerous when utilized for bazaars, with all its temporary stalls and side shows. The building must be designed to fulfil conditions of the greatest possible danger. Of course many hold that we cannot limit ourselves to controlling the *erection* of buildings, but we must seek

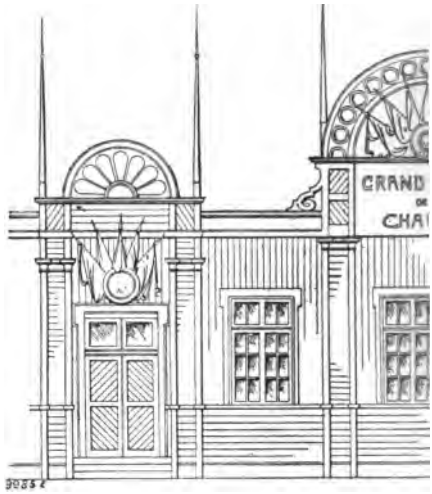
to obtain control over their *employment* and the manner in which they are equipped for its different purposes. No doubt it is just the ordinary drawing-room, the ordinary assembly-room, the school-room, etc., which is used for so many purposes for which it is never intended, and that there are many dangers incurred on that account. Such control has been attempted in some continental countries. But I think such control would be very hateful in these freer isles. We would, I am sure, rather build our houses and halls at once in such a manner as to be prepared for all risks, rather than be constantly worried by inspections and the like. What may be good for a continental country is not suitable for us. We all abominate anything like perpetual grandmotherly interference. Hence, I say, rather let us at once build suitably for all emergencies. If we do that, we need not be constantly worried. Perhaps even improvement of plan and construction at the outset in a new building appears a very serious matter to you, but think, what does it really mean in nine cases out of ten? A few extra doors, and these so hung as to swing outwards; staircases perhaps somewhat broader, and not of a dangerous hanging type; hand-rails perhaps on both sides; a few safety bolts or latches. Surely this would not even interfere with a great art-architect's design, his colour scheme or details, and would this not save us endless worries of control over all private and semi-public entertainments?

UNSUITABLE PROVISIONAL BUILDINGS.—And now comes the question of provisional buildings erected for some specific purpose, such as a bazaar, and often allowed to remain in position for some indefinite period. Again we find nothing has so far been done or decided so as to minimise danger in these structures—in fact the meaning of a temporary structure has scarcely been defined. Is the large tent, built in the garden of a private residence, a temporary structure or not in the meaning of the Act? and if so, why are such tents

erected with impunity for all manner of social functions throughout the London "Season"? To my mind the less temporary structures are encouraged the better, and this, regardless of what their character or purpose may be. But when erected, let the same importance as to planning and watching be accorded to the provisional building as is essential for a permanent structure. Let us not forget the Charity Bazaar Fire, and consistently avoid the flimsy and dangerous materials which were used for its construction. Why, we can even have temporary iron buildings at a very reasonable expense. But above everything, planning and watching should be kept strictly in mind. I am not going into details here, but if you wish to have some valuable information as to what can be done, and what the architect should bear in mind when associated with a temporary building I cannot do better than refer you to an article by Mr. H. Heathcote Statham, and published in *The Engineering Magazine* of July last.

DANGEROUS DECORATIONS.—It is not my object, as I have said, here to deal with details, neither in regard to the construction of our permanent theatres and public halls, our private drawing-rooms, nor in regard to our temporary buildings. The diagrams of the temporary structure at Paris, to repeat what I have said, serve as sufficient warning as to what must be avoided in this direction. It is likewise not my wish to enter into details on the question of equipment, for here again the diagrams will show everything that is to be condemned. There is so far, I am aware, little or no regulation as regards such equipment to-day. The matter has in fact scarcely ever been discussed, though an all-important one so far as safety of life is concerned. I do not wish to air personal opinions on the subject of equipment, for it would take a long time to explain the possibilities, etc., of the question. If, however, I may be allowed to call attention to one thing, it is to the fact that whatever the architect may do in any class of

building used for entertainment, his efforts can so easily be annulled by flimsy decorations, appointments, equipment, etc.; it is just this so-called decoration combined with carelessness on the part of the individual that is the actual cause of most fires. Apart from facilitating the escape of the individual, the architect's efforts are to a great extent limited, as far as the actual fire is concerned: first to avoiding the possibility of an outbreak occurring in connection with the structure proper, and secondly, seeing that should an outbreak occur his structure does not facilitate its spread. The architect cannot prevent a drawing-room, or a schoolroom being decorated with bunting, Liberty silk, or paper rosettes, and, as I have said, control in these matters would probably not be advisable in England. He cannot prevent the smoker "lighting up" at his smoking concert, or prevent the use of open lights, and official interference in such matters would be unacceptable to the Englishman. We can, no doubt, prevent many dangers in the usage of buildings erected for public entertainments. We could and should prohibit the wood stage of the theatre; we can prevent muslin hangings being used in the auditorium, and prohibit smoking, except in specified rooms. But such restrictions would be intolerable and extreme if applied to rooms used for private and semi-public gatherings. They would not be practicable. Thus again, we have to deal with certain well-known possibilities of fire with certain given facts, and against these facts you have to provide. The actual disuse of those Liberty silks, open lights, muslin, paper roses, in our private and semi-public entertainments, rests entirely with the good sense of the general public. Until the general public boycott them, you will have to take them into account when you are at your drawing-board, or superintending your jobs.



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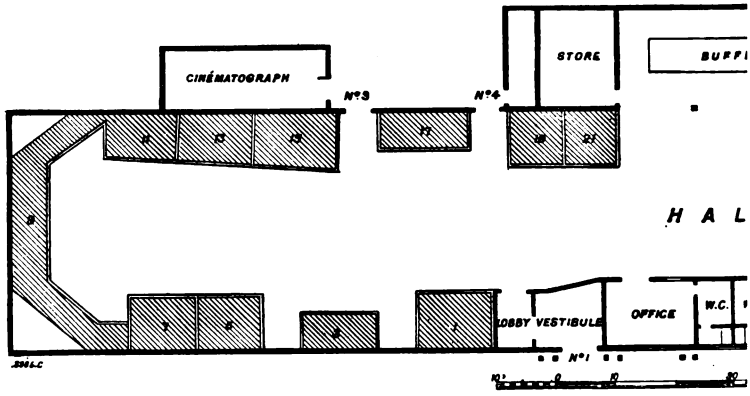

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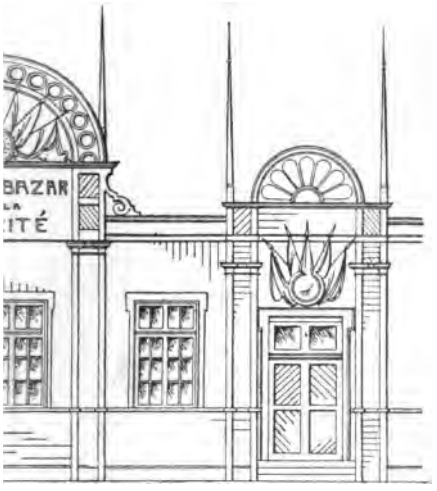

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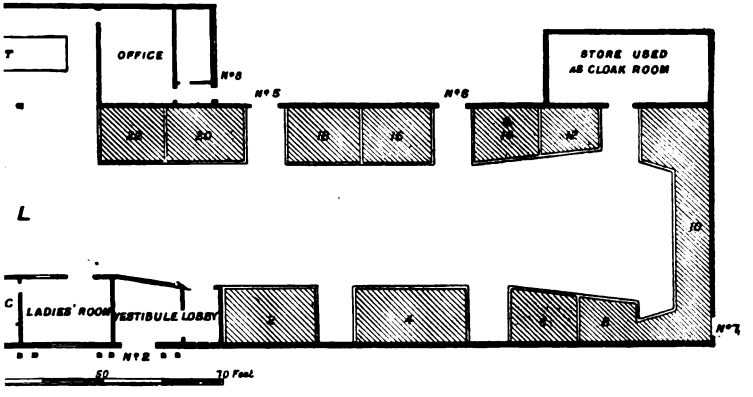

PLAN.

CONCLUSION.

And now, what is to be the remedy for the present state of affairs regarding safety of life at entertainments and gatherings of different descriptions?

The first and principal remedy, to my mind, as I have already indicated, lies in the hands of representatives of the architectural profession. It will be the architect mainly to whom we shall have to look for safety; we have to rely on the spirit with which he designs his structure, no matter what the regulations may be. At present, I am afraid safety of life is about the last thing that the designer thinks of. Safe-planning and safe-seeing [illegible] will have to become [illegible], and the practitioner [illegible] to these matters.

[illegible] for improved [illegible] will sooner or later [illegible] to a great extent, the [illegible] present there is [illegible] protection [illegible] connection [illegible] generally. [illegible] [illegible] which [illegible]

case may be, by further legislation giving the necessary powers to those in authority to intervene where necessary, and laying down the principles that have to be followed; and with new legislation, we should also remember that we shall require more officials who will in every way be capable of carrying out its administration, and the execution of any specific code with tact, knowledge, and sound common sense. Legislation on building matters always requires a certain power of discretion for the officials. We do not want the red-tape automaton so conspicuous in some Continental countries.

But how are these remedies to be brought about? Of course, after every catastrophe there is always a considerable literature forthcoming on the subject. We have had literature enough after former fires, but unfortunately, except for the steps already taken as to theatres and licensed premises both at home and abroad, it has been literature alone. There has been much writing, but very little action. It is now time to take action. We do not wish London to be the scene of a calamity similar to that by which Paris has been recently visited.

How are we to get the architect in practice to take a little interest in fire protection, not only in its general aspect, but specially in connection with our entertainments? How is the student to be encouraged to take the matter up? How, again, is the general public not only to be interested, but educated? How are our authorities to be assisted in arriving at practical conclusions and regulations, and our officials kept in touch with what is going on in these matters?

It is a big question, for I go so far as to say that in regard to the general public, we should even let the Board School "standard reader" have pretty fables dealing with the dangers of fire, rather than some of the useless stories that appear to-day. I go farther still, and say that the public press, that great

educational factor of to-day, might be induced to give us something more instructive about fires than mere reports of conflagrations. We might hear more of the origin of fires and of the possibilities of prevention.

How are we to attain these improvements? To my mind, the right note has been struck at Paris. It has said: "Call together your leading architects and surveyors, your civil and mechanical engineers, your experts in chemical and other sciences. Call together your leading officials, the leading Government and Municipal workers, and others seriously and scientifically interested in the technical and economical problems of to-day. Don't forget the leading fire brigade officers nor the owners of warehouses, theatres and other dangerous property. Combine the many conflicting interests. Don't be afraid of compromise. Avoid one-sidedness. Examine what has so far been done at home and elsewhere. Find out what proposals are stowed away in men's minds. Confer. Then act, and act soon. But mind, no one-sidedness or petty prejudices." That is the advice from Paris where it is being acted upon. Other countries will act on it too, and I hope Great Britain will be foremost among them. A small start has in fact already been made. On the initiative from Paris a small committee has been formed, which is taking up this matter of fire prevention. This committee, made up of representatives of the different interests, will soon find a way to help the architect, to see that the general public does not forget the lessons of the Paris fire, and that our legislators have sound independent assistance when required. It is fire *prevention*, mind you—preventing fires—that the committee have most to-day to think of—not putting the fire out when it is there. Let our gallant firemen look after the fire-fighting when the fire fiend is actually among us, but let us see that our firemen have as little work to do as possible, and that they are not handicapped to the extent they are at present.

DISCUSSION.

THE CHAIRMAN:
MR. HAMPDEN PRATT, F.R.I.B.A.
President, Architectural Association.

The subject which Mr. Sachs has brought before us to-night in his very interesting paper, is one which concerns all of us, not only as members of the architectural profession, but also as members of the public, and that being so, we have every reason to discuss the question freely.

We have amongst us, a number of gentlemen who do not belong to our profession, and we therefore have an excellent opportunity of hearing different aspects of the matter dealt with. I hope that so interesting a subject will provoke a good discussion, and as we have with us, the Vice-chairman of the Theatres Committee of the London County Council, Mr. Roberts, I will now ask him to open the discussion by giving us his views on Mr. Sachs' paper.

MR. RICHARD ROBERTS:
Vice-Chairman, Theatres Committee, London County Council;

I am glad to have the opportunity of hearing Mr. Sachs' paper. It is not the first time I have heard him in this room, and I think we are all indebted to him for the continuous interest he takes in this important question. I think it is necessary to keep the public mind alive on such questions as safety from fire; we are far too apt to forget the dangers with which we are surrounded.

If I were to make any criticism on Mr. Sachs' paper, I should say that it was imbued very thoroughly with

the scientific spirit, but, perhaps, not quite so much with sentiment, for I see he goes so far as to say that the children in our Board Schools should have, what I might term lessons on danger from fire. Now, I do not quite favour that opinion. I still prefer that our children should be taught the tales of King Arthur and the Knights of the Round Table than anything propagated in this paper. But be that as it may, speaking generally, it is absolutely necessary to draw attention to the dangers of this kind with which we are surrounded.

The County Council, as we all know, has done considerable work in the direction of fire prevention, and here I should perhaps point out that its members have been very ably advised and guided by its permanent officials. Mr. Blashill, the Superintending Architect, has done much in this direction. To give an example how our chief official is alive to every aspect and every lesson taught us in the matter, you will remember that Mr. Sachs pointed out that the velum in the Paris Bazaar disaster was the cause of great danger. Now only quite recently Mr. Blashill called attention to the velum at a very large show opened in London. Of course we asked for its removal.

I believe there is much in the suggestion which has been put forward in Mr. Sachs' paper in regard to watching and planning. The Council already sees that theatres are properly provided with the necessary number of exits, also that there is a proper site, but there should be more attention given to planning and continuous watching should be insisted on. As to watching particularly, I believe very often the fires at entertainments could be prevented by some systematic arrangement. We can certainly be more on our guard in this direction than we have been in the past. As to better planning, I am hopeful that Mr. Sachs will make an impression upon the younger generation I see around me, and that we shall have our buildings in future designed with a view to greater safety.

But if our architects of to-day are not alive to risks of fire, how can we expect the general public to be more careful? If you, with all your knowledge and all the learning you have as to materials, constantly run risks, and let others run risks, you must expect the general public to do so also. If we are anxious to minimise our risks we must take the matter up and we must take public opinion with us, and I think the officials of the London County Council will support me in this opinion.

Speaking again of the County Council officials, we owe a great deal to Mr. Blashill and his assistants, because they continue to press this important point of danger from fire, and danger from panic. Our officials make their requisitions, and make them to a good and high standard. If any regulation is modified it is not by the action of the officials; it is by the Committee. It is the layman who tries to make the requirements for safety less onerous to the property holder, for he is aware of the expense they will involve.

As to provisional buildings, I should lay stress on the fact that I consider the dangers of temporary structures particularly serious. I am very sorry myself to see any application for temporary buildings in London, and the generally accepted practice of the Building Act Committee, of which I am a member, is never to grant permission for a temporary building, except for a school, or for a religious or philanthropic purpose. We do not now grant permission for temporary structures for entertainments, and certainly never for trade purposes. Mr. Sachs has very wisely put his finger on the point of danger in temporary buildings. All buildings used for entertainments should be permanent and well built, and I think you should set your face as far as you possibly can against temporary buildings of any kind. Of course temporary structures are often erected without our permission. There are tents for balls, for weddings, and other occasions of that sort. I remember that in the early days of the Council, when perhaps it was a

more radical body than it is now, we even threatened a Duke because he set up a tent without permission, I believe on the occasion of his wedding. The Duke, I am glad to say, guided by his architect, saw the matter in the right light, and applied to the Council for permission, so that no proceedings had to be taken against his Grace.

If I may make another remark it is that there is a general opinion that payment is necessary to make an entertainment public. Now, if the public can get into a place with or without payment, and if there is music or dancing, it really requires a licence, so that in England payment is not necessary to make premises a place of public entertainment.

In conclusion, I would say a word of praise for the new suburban theatres which are springing up around London, and are built under our regulations. They are well constructed and their sites are good. I shall not here say anything about their artistic merits. Let us be charitable, and perhaps say that their owners spend so much in better sites and improved construction that they have no money to spare for artistic display. The County Council cannot, however, be held responsible for the lack of merit in the architectural rendering, for its duty is to preserve the lives of the public at all costs, and in this we hope to be always assisted by architects.

I must again repeat that Mr. Sachs' subject is a very important one, and that he has dealt with it in a very able and instructive manner.

MR. SIDNEY GAMBLE, A. M. Inst. C.E., F.S.I.,

Second Officer, Metropolitan Fire Brigade.
Vice-President, National Fire Brigades' Union.

I have heard Mr. Sachs' paper with very great interest and he brings out many points. Of course, the actual combating of a fire was not touched on to any considerable extent, and Mr. Sachs is quite right in restricting himself to fire prevention before a body of

architects, inasmuch as the scope of the architect's work is limited to planning and construction. I notice Mr. Sachs uses the term "slow-burning" construction, and this is an improvement on the usual expression "fire-proof," a term which is quite out of all reason.

Speaking of theatre fires and the advisability of having clear and well-planned corridors and staircases, I would remind you of the Oporto fire which Mr. Sachs referred to, where over a hundred lives were lost. All the people had safely left the auditorium, but, unfortunately, many either lost their way or got blocked on the staircases and corridors, and were crushed or suffocated there.

The next point, as to deaths from fire generally. Well, deaths from fire arise, of course, from many different causes. In London we try as far as possible to keep a careful record of all the deaths that occur, but the bulk of those that happen in London are due to the person's clothing coming into contact with fires in open grates, or by mineral lamps exploding or leaking. The actual fire is often very small indeed, in fact, frequently there is hardly any fire to speak about. Mr. Sachs' wording would imply that the £7,000,000 loss of property by fire and the lives lost coincide proportionately the one with the other, but that is not the case. Much property is frequently lost without any injury to the owners or occupiers or their employées.

Mention was made in the paper how architects press upon local authorities to relax their regulations in relation to fire prevention. It is 25 years ago since I was first appointed as a building official. I acted as Borough Surveyor for many years, and I can confirm Mr. Sachs' view that architects often try very hard to evade the regulations. I had much trouble to make them conform to certain regulations, and though I never agreed to relaxing any of the existing regulations, my committees often moderated the requisitions, which seems to bear out to a certain extent what Mr. Roberts has said in regard to the officials and lay committees.

Now as to panic. Well, a panic may occur from the most trivial of causes. It has been my good luck only to be in a panic once. It occurred in a large building in London, and was solely due to a woman having gone into hysterics and making a disturbance. That will show you how small a matter may cause a very serious loss of life.

Mr. Sachs mentioned, with regard to the Paris fire, that the glass in the roof went very early. Well, unless he has got definite information upon that point I very much doubt it. I rather think that the glass would have stood the fire for a very considerable time. Glass will stand for a long time, unless cold water is thrown on it. If the glass had fallen in good time, I should have thought it a very good thing, for then the smoke would have got away. I should like to know if Mr. Sachs has got definite information upon that point.

Another question I would like to touch upon is that a number of people who got into the enclosure at the back of the building were burnt. There can be no doubt about it that intense heat playing upon the flesh has a most disastrous effect in a very short time. It is impossible to say how long a time; but, in my own mind, where a person gets close to any great heat, it is only a question of seconds, and from what I have seen of bodies it must have been almost instantaneous death.

Then with regard to public entertainments generally, mention has been made of inspection. Well, of course no amount of inspection on the lines we have it in London will stop a burning place from being a death trap: we require something more consistent. From that serious fire at Oporto have arisen very stringent regulations. Managers are not allowed to open a building for entertainments until they get a certificate from the chief officer of the fire brigade shewing that all the exits have been carefully inspected, and that all the appliances are in order. Some arrangement of this kind might, with advantage, be carried out in England.

As to watching Mr. Sachs is quite right; the importance is underrated. I am afraid that the private firemen doing duty at London theatres are at the beck and call of any of the staff to run errands and do odd jobs. This is a very unsatisfactory state of affairs.

There is one point that has not been touched upon, and that is, that many buildings are so altered after they have been first erected, that they become very dangerous. It is one of the great troubles that we firemen have to deal with, that these buildings have been cut about after the architect has done his work. Many of these alterations have been done without the authorities knowing anything about it. I have in my mind at the present moment a case of a house being turned into a dancing academy, and then, at a fire, unexpectedly collapsing. We lost two of our firemen in that case; and their deaths were due solely to the alterations which had been indiscriminately made in the structure.

In conclusion, I do not see that any general regulations could ever be drawn out applicable to all countries and all localities, though the principles of safe building might be determined at an International Conference. As to the Committee which Mr. Sachs mentioned, there is every reason to hope that we may benefit by its efforts.

MAJOR FOX.

Chief Officer, Salvage Corps.

I can only endorse the views which have been expressed by Mr. Sachs, and am sure you must all have listened to him with great interest. I had an opportunity of viewing the ruins of the Paris Bazaar within twenty-four hours of the outbreak, and I was not astonished at what I saw and heard, knowing that it was merely a wooden shed fitted with canvas. As to the destruction of the building, I can assure you that what was left could have easily been put into a single van. Of course, it was an error of judgment to fill a building like that with ladies

wearing flimsy dresses, and, of course, it was a mistake to have an entertainment of that sort going on in such a place, but, as Mr. Sachs always says, it is very easy to be wise after the event. If there is panic, as is more often than not, you have loss of life. Panic is always the trouble, no matter what the cause.

The subject of churches, only casually mentioned by Mr. Sachs, is a very serious one. We all recollect the terrible disaster in Santiago. It would be only fair if churches were examined just as well as other public buildings. If you were to go into the gallery of some of our churches, and notice the length of time they take to clear it, looking at the matter in view of what has taken place in the past, you will at once conclude that a great many people must be injured in case of panic. I do not say that as an alarmist. I have been called over the coals for expressing my opinions too freely, but attention must be called to existing anomalies. After all, lives were lost at the Paris fire owing solely to the fact that no one had directed attention to the danger of having such temporary buildings. I only hope that something may now be done which will result in some good either by the working of the committee referred to, or in some other way. Great credit, it should always be remembered, is due to the London County Council officials for the trouble they take. Anyone who sees the time and labour they expend must feel that they do everything in their power to minimise existing dangers.

Touching on a matter of detail, I certainly agree with Mr. Gamble that the breaking of the glass was not the cause of extra danger. It would have been better if the glass had gone sooner than it did. You will find if water gets upon it, it will only crackle, and will not break for a long time, which holds the fire in. The great danger, however, in the Paris building, as Mr. Sachs points out, was undoubtedly the velum, and when it dropped on to the people's heads there was really no hope for them.

I have studied the subject very deeply, and I can only thank Mr. Sachs for his very excellent paper. I am sure that increasing good must come from the work he has taken up and the discussion of the subject on broad lines which is likely to ensue.

MR. THOMAS BLASHILL, F.R.I.B.A., F.S.I.
Superintending Architect, London County Council.
Member of Council, Royal Institute of British Architects.

I am very pleased to be here this evening. I did not, however, expect the very kind comments that Mr. Roberts was good enough to make upon myself and my staff. I must thank him very much for that. I am bound to admit, as Mr. Roberts indicated, that in dealing with places of public entertainment I feel it a duty to see that nothing that can be done to minimise danger is omitted. I certainly do not omit to call the attention of the committee to any danger that I may notice. This committee of laymen, as Mr. Roberts calls it, represent the public, and if it modifies any of my requirements, it surely knows how much risk the public are entitled to take better than I can.

As to Mr. Sachs' comments on the general public, my opinion is that the public does not take any interest in fire precautions at all; in fact, they do not take the slightest interest in fire until the moment it breaks out, and then only for a few days after the disaster.

As to those who are responsible for the various kinds of entertainments, I also think that the managers connected with our theatres and music halls are not by any means the most unfriendly to fire prevention, though their money has to be locked up in making improvements, and financial considerations make them, perhaps, a little cool when talking about danger. The persons with whom I have come in contact, and of whom I have greater fear, are the persons who are connected with temporary entertainments—clergymen, schoolmasters, or philanthropic persons who wish to have a provisional structure with a stage or music license for a short time

only, and no doubt for some charitable purpose. They are absolutely reckless. I assure you I have never been able to make the slightest impression upon them. In my opinion these temporary structures are a source of danger, and we must be more stringent with them.

As to theatre construction, I am very pleased to say that with the experience of ten years it is to-day somewhat rare to find a theatre proposed with a thoroughly bad design; and it is very rarely that one has to use forcible arguments to obtain the improvement of such plans. If errors are pointed out I am glad to say that an attempt is now generally at once made to correct them.

Now with regard to the Paris fire, I have said frequently, and I say now to the architect, that to a really practical man conversant with the subject of Fire Protection the Paris fire conveys no lesson whatever. There is no person who has had experience in such matters, but knows that the whole thing was a mass of recklessness in management, and in the use of the place. The Paris fire was the outcome of the greatest combination of improper reckless proceedings that I ever met with in the course of my life; and yet that fire will have to be an object lesson to a vast majority of professional men, not to speak of the public.

Now may I hint just at one or two things one has to go through in an official capacity? I and my staff with great pains, approved a drawing for the re-arrangement of a very large building for adaptation for one of these great entertainments that are now so common in London. After struggles with the parties concerned and with my committee, the thing was got into such a shape that it was just about ready to be opened, and on the day before the opening, as is a common practice with me, I went with the head of the theatre department to have a look at it. I do not want to indicate the place, but it was a good size and had seating for a large number of people, in fact some thousands of lives were involved every night. Now during our absence somebody had apparently

thought of a little extra decoration, and I should think thousands of strings had been hung down from the top of that building, and at the end of these strings were large sheets of paper. A light velarium had been added of course. Then there were also a large number of columns in the place, and every one of these columns were wreathed with these paper flowers, and I have not the slightest doubt that with a wax match I could have set the place irredeemably on fire. That is one of the things we have to contend with, and you must remember as architects that directly the building gets out of the hands of the architects, it gets into the hands of people who are more reckless than they are themselves. Take a theatre. Scenery will be stacked in the staircases, and also immediately outside the doors. One night I went to a theatre and found every exit door locked. I enquired for the manager of the theatre. He came, and I told him of it. "Oh yes," he said, "that is quite right; I have got the key in my pocket. It is all right. I can run round and unlock the doors, if they are wanted."

Now to give you an idea also of a few of the dangers I have to deal with, in regard to occasional licenses, architects sometimes come to me and say it is only for *one* night. It is difficult to persuade them that there is absolutely the same danger per night as in a place used all the year round.

As to semi-public entertainments I am quite prepared to say that I see no logical reason why, if music or dancing is not to be performed in a particular building, it should be less protected than if it were in any other place. Every audience ought to be protected. If I invite a thousand friends to my private house, they must come at their own risk, but with regard to licensed buildings—remember, it is not a question of payment, it is a question of the public invitation—we do our best to protect them. I think that every large audience ought to be protected.

I agree very largely with what Mr. Sachs has said, and I shall not repeat or emphasize any of his remarks; but, in conclusion, there is one word I should like to say to architects. Young architects will forgive me if I address my remarks to them. Suppose an architect comes to the offices of my Council and tries to over-persuade me to do that which I do not think he ought to be allowed to do; suppose he pursues the matter to the Committee, and he induces this lay Committee to think that the requisitions are very hard. Now suppose this has taken place. In what position would this architect be if it came to an inquest? He would be in the position of the only professional man who, contrary to advice, had put his approbation upon this scheme. Now, I think it is very unfair for men, who do not intend to take any responsibility themselves, to be perfectly satisfied when they get a Council or Committee to agree with their views, and then to consider themselves exonerated in case of disaster.

In conclusion I would only say that I shall be very happy if I can be of any use in furthering the question of protection.

MR. WILLIAM ARCHER.

I need not say with what deep interest I have listened to Mr. Sachs' paper this evening. I am, perhaps, one who has more personal interest, in a sense, in this matter than almost anybody present, because my business is to frequent theatres. I think I spend at least two nights a week of my life in theatres. I am always running very considerable risk, and am naturally very much interested in anything which may tend to minimise that risk. I am exceedingly glad to hear Mr. Sachs addressing this profession in such "straight talk" as he has done. It is the architect to whom we have to look to for our future theatres. I am exceedingly glad to hear of the improvement shown in our suburban theatres. Unfortunately, my business does not take me

to those theatres, but only to West-end theatres, and I cannot say the appearance of these buildings ministers to my comfort at all.

Of course, these West-end theatres are mostly old structures placed on more or less inconvenient sites. I hope the London County Council are looking to the sites as well as to the building of theatres. No doubt, that as long as theatres are set away in holes and corners, there will always be a difficulty in acquiring proper exits. Some of the older houses I seldom enter without feeling that I shall be exceedingly thankful if I get out of them safely. Perhaps I am nervous in these matters, but it would be well if the public were more nervous. They put up with a great deal of laxity which should be very easily dealt with. Mr. Blashill very truly said that the public do not care a rap for fire prevention. It is quite true they have not enough imagination to think, "I, myself, am in danger."

I will not mention names, but there are certain theatres present in my mind in which the construction and the arrangements for safety are exceedingly bad.

Mr. Sachs warned the architects that unless they are careful they may be held responsible. I certainly think that personal responsibility would materially help matters.

Mr. Sachs has spoken of a committee which is going to undertake, I presume, the education of public opinion on questions of fire prevention. I think a great deal might be done by such a committee by simply keeping public attention fixed on the matter.

There is one point that strikes me in speaking of public opinion, a matter to which this committee might give attention. No one has any confidence in the emergency exit or extra exit. I see at almost every theatre "extra exits in case of need," or "emergency doors," but so far as I know I never see these doors open, and no one uses them, the emergency not having, arisen of course. But I should like to feel that these doors can

really open in cases of emergency, and it seems to me that a regulation might be very well enforced to guarantee that these doors are really open every evening. I mean that something should be done beyond the ordinary inspection to see that they are open. Everyone should feel that if he wishes to go out he is able to go out that way. We want public confidence in the emergency exit. That confidence does not exist at present.

Of course, it is a very happy thing in a way that people are so unimpressionable and do not realise the dangers which they run. Perhaps it would be even better that there should be an occasional loss of life than that we should go about shaking in our shoes because we are afraid of fire, but that is no reason whatever why every possible means should not be taken to prevent its occurrence and to facilitate the escape of the public in case of an outbreak. Panic, as Mr. Sachs said, is the great danger, but the way surely, to avoid panic is to enable the audience to realise that, whatever happens, there will be no necessity to rush and scramble, because they can get out if they take it easy. Consequently, there cannot be too much discussion on the points which Mr. Sachs has so interestingly dealt with, and he, and this Committee which he foreshadows, will be doing excellent service in keeping public attention directed to these topics.

CAPTAIN DYSON.

Chief Officer, Windsor Fire Brigade.

I am sure after the remarks of Mr. Gamble and Major Fox, you will not expect much from me, but I assure you that I came here with a great deal of pleasure, and I have attentively listened to Mr. Sachs' instructive paper. I have been over many of the continental theatres with him, and know what has been done elsewhere with regard to the facilities. In fact the protection of our entertainments has had my serious

attention, and I can well bear out what he says on the matter.

With regard to the Paris fire, from a provincial fireman's point of view, I really do not know what we can be expected to do in the country when so little has apparently been done in our capitals so far as the semi-public and private entertainments are concerned. The greatest wonder is that such a flimsy building as the one under discussion should have been possible in Paris.

With regard to Mr. Sachs' remarks on modern construction, if we have a serious fire in Windsor, we always hope that it is an old house, for we find there the beams are of good thickness, that there is no danger of the walls falling, while in a new house the danger of bad construction seems always present.

As to warning the public, why not at this coming season begin at once by warning the public as to the risk of certain forms of Christmas decorations, and so forth; it might save many a life.

I assure you it has been of great interest to me to be present at the meeting.

MR. HENRY LOVEGROVE, A.R.I.B.A., F.S.I.
District Surveyor for Shoreditch, Vice-President, Society of Architects.

I have very much pleasure in proposing a vote of thanks to Mr. Sachs for his interesting paper. He has devoted a great deal of time in Great Britain and on the Continent to the question of fire-resisting materials and the proper arrangement of our public buildings, and his work has been of great service to the profession and to the public. I have followed his paper with very great pleasure, more especially as I have for many years gone into the question of fire-resisting construction.

Mr. Sachs mentioned how the authorities are frequently set at defiance. I do not think that that opposition is politic. It is not many years since an important set of requisitions was fought to the last letter. The only

result was extra costs in addition to the expenditure for alterations.

As to provisional structures generally, never a week passes but a client comes to me about temporary buildings. I am very glad to hear Mr. Roberts speak about stopping them, and I can only wish we had some legislation which would be retrospective in regard to them, so that everything standing at present of this character could be pulled down. Perhaps I should add that I know also of many permanent buildings which have been years ago joined together by temporary structures, and the consequence is that, should a fire occur in one of the blocks, the flames would easily spread and adjoining structures would be gutted.

As to places of entertainment, what we can primarily do is to provide proper exits, and I am glad to say that plans submitted to-day are very much better than those presented some years ago.

I am also glad to hear Major Fox mention places of worship. In a large building such as a church or a chapel what a dreadful thing it would be to have a panic, and there are hundreds of churches in London which are in no way arranged for the rapid dispersion of the congregation.

In conclusion, I would repeat that I am very pleased to propose a hearty vote of thanks to Mr. Sachs for providing so interesting a paper this evening, and also for going a little out of the beaten track.

MR. MAX CLARKE, A.R.I.B.A.

I am very pleased to second the vote of thanks to Mr. Sachs for his very interesting paper, though I should at once say that I entirely disagree with him as to the responsible position which he says the architect occupies. I have had something to do with theatre building, and on more than one occasion the question has been put to me whether it is not a mere speculation for any man to

have a theatre built for him, and whether if the architect who can give the speculator the greatest value for his money is not the most successful man. Yes, that is quite true, and unfortunately it necessitates building in a manner which is more or less cheap. The responsibility for the building which is more or less cheap, however, to my mind, rests solely with the speculator and not with the architect. I think that my theory about the owners of theatres will be amply borne out by any gentleman who takes the trouble to look up the series of letters that appeared in all the London papers when legislation was proposed by the County Council on this matter. If anyone reads those letters he will see very clearly what are the views of the managers themselves.

Then Mr. Sachs advocates the view that good planning is to be given preference to fire-resisting construction. Now I, as an architect, could not for one moment imagine that any of the men who build theatres can make anything out of that advice. We must take architects according to their lights, and I am sure they always presume that their plans are good plans. Assuming, however, that we get a good plan, and that the official expert has enlightened us upon those points which he does not consider good, I take it that, according to Mr. Sachs, he is then also to tell us what kind of construction he wants, but not the other way about. To my mind, however, it is of the greatest importance to use, wherever possible, fire-resisting material. I am well acquainted with all the theories that are held in regard to these materials, and I hold that when a building is composed of iron and steel, unless it is crowded with inflammable material, it will not catch fire, and will not generate a great amount of smoke before the audience has time to get away. Remember, nearly all the great theatre fires we speak about have been in buildings of an inflammable nature. Most of the theatres in which fatal fires have occurred had much timber-work, and owing to the heat such timber soon becomes highly inflammable.

Referring again to building materials, I hold that no part of the construction of a theatre in the future, not even the roof, should be of wood, and that only materials should be used which prevent the flame from spreading rapidly.

As to public opinion on fires, more especially as regards the safety of places of entertainment, the panics that regularly occur are sufficient evidence that the audience has a very shrewd suspicion of what will transpire if a fire happens. As a rule they do not care to think of fire, or they hope such fires will not occur in their lifetime. But lack of confidence in the buildings visited by the public is the cause of the panic whenever a fire actually occurs.

As to details. We have heard some remarks as to glass not breaking so rapidly under heat as some people think. May I ask, then, why the fanlights over our stages are ordered to be glazed? Then glazing, I thought, was intended to break to let the smoke out.

With regard to the velum, are we never to have a velum any more? Is it not possible to make these sheets so that they will not burn? Because if not, the sooner they are removed the better. But I think there are several chemical preparations which would prevent their burning, and I would call your attention to these preparations which are as a rule neglected.

A great many years ago I had some prepared linen sent from America, which was quite non-flammable then and is quite non-flammable now. Ought not many of our materials to be prepared in such a way that they will not take fire? It would be interesting to know if we could not make everything in a theatre non-flammable.

Referring again to public opinion, let us remember that we have to-day not only to think of the public mind, but also of the state of the Press mind. I have here a cutting from a leading morning paper, and a typical phrase in the description of a new theatre is, "One

of those hideous things known as iron curtains has been dispensed with, as the arrangements for checking fire are perfect and complete." Now surely that is impossible. There is not a theatre in London where the arrangements for checking fire are absolutely complete. The opinions expressed in the Press are often as ridiculous as misleading.

Speaking of iron curtains, what the County Council ought to do is to provide some sort of fire partition between the stage and the auditorium, so that if a fire breaks out on the stage the public may be protected. In new theatres no doubt this is already compulsory, but the old theatres want it most.

Speaking of actual fires, one of the ladies sitting in the dress-circle of the Exeter theatre and with whom I had a conversation two days after the fatal fire, told me that within three minutes of the outbreak occurring the heat had become so great that she could not remain sitting there. She was quite composed but had to leave her place almost immediately owing to the heat.

In conclusion, I would again call upon you for the vote of thanks to Mr. Sachs for his very able paper.

THE CHAIRMAN.

I am sure we are very much indebted to Mr. Sachs for bringing such an interesting subject before us. It has provoked a very good discussion, and no doubt there are many present who would like to continue it, but I am afraid our time has gone. I am sure we are indebted very much to these gentlemen from the County Council and from the fire brigades who have come to our meeting and have given us notes from their actual experience. We must also thank Mr. Archer for expressing his views as a playgoer.

With regard to the lessons from the Paris fire, I think the principal one is that the conflagration has called our attention to the risks of semi-public entertainments.

We have often heard about our theatres and music-halls which, in my opinion, so far as recent buildings are concerned are very well taken care of. The London County Council regulations are valuable and have been very well applied, and so far as the construction of our new theatres is concerned, we have really little to complain of at the present time. With regard to entertainments held in provisional buildings, however, there is still great danger, and, similarly, there are still great risks in those large places of amusement which do not come under licensing laws, no matter if they are used for private or semi-public amusements.

As to improvements in the safety of our semi-public and private entertainments, I hold that there is no doubt that the careful watching of the premises is one of the best precautions we can take. You may have a building which is badly planned, but if it is thoroughly well watched, much of the risk is at once done away with.

Mr. Sachs has drawn our attention, as architects, to the necessity of better planning, and he has done us (and the public) a good turn. No doubt, if we were to think a little more about the dangers from fire and from panic, we might be induced to consider our exits and our passages more carefully. I am not speaking particularly of theatres, but of all buildings, including dwellings. I am very glad that churches have also been mentioned, because there is a considerable amount of risk in our places of worship. Perhaps I should say, however, that in planning our buildings well, as far as rapid exit is concerned, it is not fire we have got to plan against, but panic; panic rather than fire.

As to the remarks that Mr. Max Clarke has just made there is no doubt that even if we have a well-planned building we have not attained all that we ought to do as architects. But architects are already paying some little attention to fire-resisting materials whilst safe planning seems to be overlooked. I would hence repeat that Mr. Sachs has done well to advise us to plan our

buildings safely, so that the occupiers may have a ready exit in case of fire, and that fire risks may be also separated as much as possible.

I have very much pleasure in putting to you this vote of thanks, which I am sure you will carry with acclamation.

MR. EDWIN O. SACHS,
In Reply:—

I must express my appreciation of the vote of thanks which has been so kindly proposed by Mr. Lovegrove and so courteously put by your Chairman.

One of the first questions that was asked in the discussion was in reference to glass. Both Mr. Gamble and Mr. Fox are quite right in saying that glass has great power of resistance. But a brittle and very thin glass was used in the Paris bazaar building, and I should not be surprised if it was already cracked, and had holes in it before the fire. At all events I do not think that the material used could have stood the fire long. With regard to the actual time of the glass-breaking, the only evidence I hold is to the effect that immediately the velum caught fire the glass was heard to break, and fell on the ladies below, in many cases cutting their heads and necks.

As to death by heat, there is no doubt that people are killed very rapidly, and there is always an accelerated development of heat where we have burning canvas. The intensity of the heat at the Paris conflagration was, however, quite abnormal.

With regard to extra exits in theatres, there are, of course, the usual requirements that the doors are to be fastened by panic bolts only, and I know that the officials are always on the alert to see that the bolts are in working order. But we certainly want something more, above all, the confidence of the public in emergency exits.

I am not quite such an opponent of fire-resisting

construction, as Mr. Clarke thinks, or certainly not to the extent to which he has expressed himself. What I do say, is that a stone staircase is of little use if its route is tortuous. I would rather have a shorter, straightforward route of a more inflammable material.

As to the non-flammability of materials, that is a question of the future. The matter is in its infancy and much handicapped by the fact that we never get good independent opinions on the inventions put before us. We only hear the manufacturer's stories, or those of his friends or paid helpers. An absolutely independent committee to investigate the matter would be of great use, and, if feasible, the Committee I spoke of may take the matter up. Such independent investigations have already been successfully attempted in a small way at New York, Berlin and Hamburg. The sooner we have independent tests in this country the better.

As regards churches, I certainly think that the very first precaution necessary is in respect to the doors. All our existing churches should at least have their doors altered so as to swing outwards.

In conclusion I would again thank you for your vote of thanks, and I would only add how delighted I shall be if my paper has been of some little use.

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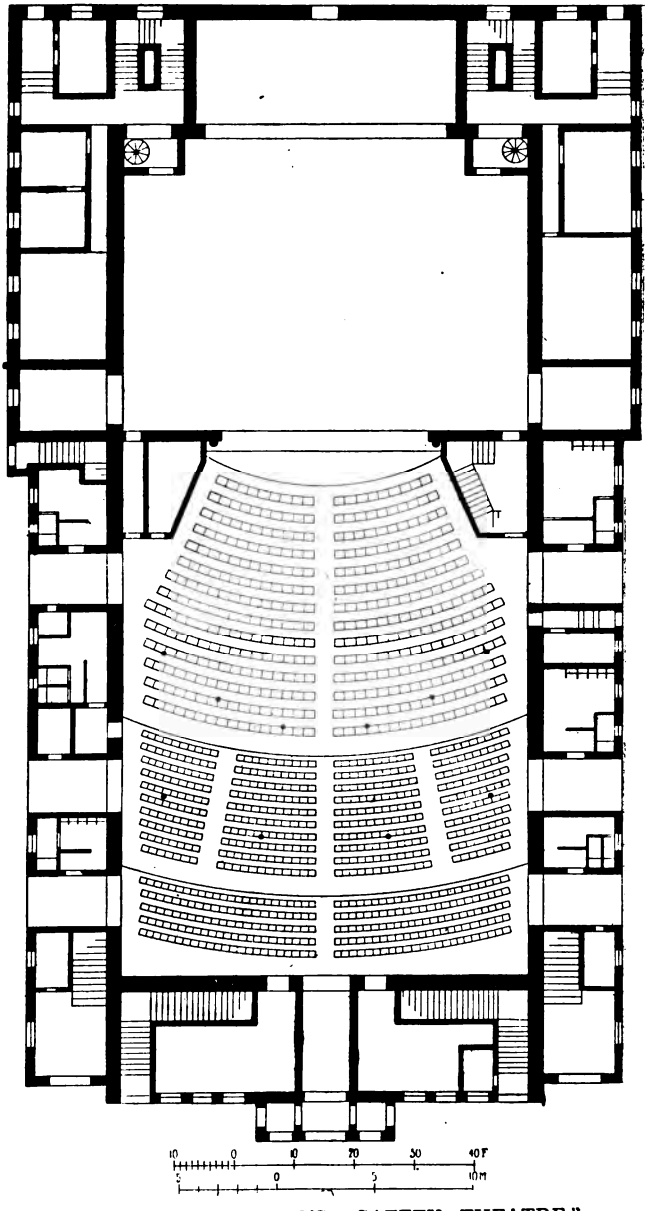

SIR HENRY IRVING'S "SAFETY THEATRE."

AREA PLAN.

Publications of the

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Edited by Edwin O. Sachs.

THEATRE EXITS

A Paper

BY

ALFRED DARBYSHIRE,

ARCHITECT,

FELLOW OF THE SOCIETY OF ANTIQUARIES,

FELLOW OF THE ROYAL INSTITUTE OF BRITISH ARCHITECTS,

ETC., ETC.

WITH

A DESCRIPTION AND PLAN

OF

SIR HENRY IRVING'S

"SAFETY THEATRE."

LONDON, 1898.

—

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No. 1.—WHAT IS FIRE PROTECTION?

No. 2.—AMERICAN OPINIONS ON FIRE PREVENTION.

No. 3.—THE PARIS BAZAAR FIRE.

No. 4.—THEATRE EXITS.

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NOTE.

THE Safety of our Places of Public Entertainment should always merit the attention of those interested in Fire Prevention, for nowhere can an outbreak—or even the semblance of an outbreak—more easily involve considerable loss of life than in our Theatres, Circus Buildings, and Assembly Rooms. Experts have frequently differed as to the relative importance of the planning of such establishments, compared with, say, the construction of the building, or the equipment of the premises with fire-extinguishing apparatus. Many of our leading authorities most distinctly advocate the primary consideration of the exit above all other questions. Among the latter are Mr. Alfred Darbyshire, of Manchester, whose Paper is here presented, and with him Sir Henry Irving, who some years ago gave considerable time to the matter. Mr. Darbyshire's arguments speak for themselves, but I have thought it advisable to add an Appendix and an illustration, embodying the ideas of Sir Henry Irving, with whom Mr. Darbyshire was associated in drawing up a scheme for a so-called "Safety Theatre." It is not often in the annals of the Stage that a prominent actor devotes so much attention to the safety of his audience as is here the case. Nor have we many architects who have given so much thought to the question as Mr. Darbyshire. As what I might term the joint presentation of the views of architect and actor, I believe this publication should not only merit the consideration of the technical profession, but of our public authorities.

We have certainly before us a clear case for the primary importance of the exit, and it is the exit which must naturally interest the playgoer above all other questions of theatre safety. Whatever construction may do to minimise the risk of an outbreak, and the equipment to prevent the spread of fire, there is no doubt that given an outbreak or a panic, clear exits and good planning will principally contribute to the safety of an audience, and everything we can do to ensure good exits should be done, even if some of the other requirements of modern theatre construction have to be given a second place. Of course, theatre safety must always be treated as a whole both by the architect and the authorities, nevertheless, as far as the audience is concerned there can be no doubt that suitable exits and straightforward planning should be given precedence.

EDWIN O. SACHS.

London,
February 7th, 1898.

THEATRE EXITS.

IN the year 1869 my attention was drawn to Theatre Architecture. I was consulted by the proprietors of the Prince's Theatre, in the city of Manchester, with a view to various alterations and improvements in the little house which afterwards becomes famous for the production of the Shakespearian drama. It was during the progress of this work that I became conscious of the shortcomings of English theatre planning, in the matter of safety to the public in case of panic. Like many other theatres, the Manchester Prince's was built in between other properties, with only means of exit on the street façade for the public; the stage and its adjuncts being approached from a back street. Without forming, at the time I am speaking of, any definite ideas as to what should be done to avoid these unsatisfactory conditions, I was nevertheless convinced that, in the event of fire panic, the consequences would be fatal and disastrous.

Theatre architecture, however, still continued on these unsatisfactory lines, and it was not until the year 1887, when the awful disaster occurred at the Exeter theatre, that the public mind became thoroughly aroused to the inadequacy of English theatre planning and construction. It was after this tragedy at Exeter, that our great actor-manager, Sir Henry Irving, consulted me on the possibility of designing a theatre which should possess all the elements of safety to the frequenters of the play-house.

During my frequent work in connection with theatre architecture, I had gradually formulated plans of reform.

I was therefore prepared to enter heartily into the solution of the problem which Sir Henry Irving submitted for my serious consideration. I will explain the conclusions arrived at after careful thought and much discussion, and allude to the practical working out of those conclusions in theatres actually erected on the lines of the scheme which we jointly formulated.

At this point I may say that I believe the time has arrived when theatre planning must be subjected to Municipal or State control, and I cannot understand how any argument can be advanced against such a proposition. It is my firm conviction that every detail of arrangement and construction should be distinctly fixed, and that it should be impossible for any theatre of the future to be erected, unless in strict conformity with rules and regulations of some recognized authority, for the safety of theatrical or other audiences using public buildings, The time has arrived for a complete revolution in theatre planning, and adequate provision in the way of exit must be insisted upon, in all buildings where the public are to be gathered in any numbers. We must get rid of prejudice in favour of the old system, and, as Hamlet says, "reform it altogether."

It is not my purpose in this paper to consider fire-resisting construction, or fire extinction. These matters are of secondary importance when the safety of a public audience has to be secured. What is the meaning of the word safety as applied to an audience, or to a mass of people in a public building? There can be only one opinion on this point. It means the provision of *instant and direct escape* from a building, when attacked by fire; in other words, clear and adequate planning. Mr. Sachs, in his excellent paper on the dreadful Paris Charity Bazaar fire has used these words: "Personally, I hold that for a theatre or music hall, clear planning is of greater importance to the audience than clever forms of construction, or the employment of materials having considerable power of fire resistance." These words embody a great truth, and they represent exactly the

method and practice I have endeavoured to maintain since the disaster at Exeter in 1887.

The provision of *instant and direct escape*, or in other words, clear planning, is the subject on which I propose to offer a few remarks in this paper.

The whole question of safe theatre planning may be described in one sentence—namely, *ample and direct means of exit.* After this condition has been realized, fire-proof construction and fire extinction appliances may be considered. In other words, after the destruction of human life has been reduced to a minimum or rendered impossible, the destruction of property may receive that consideration calculated to reduce monetary loss.

It will be at once admitted that, in order to secure complete and perfect exit from a theatre, the building must stand on an isolated site; in other words, that it must be surrounded either by open spaces, streets, or roads. I shall be told that this is (especially in the Metropolis,) a condition impossible of realization. My reply to such an allegation is, that possible or impossible of realization, I would so order legislation, that no theatre of the future should be allowed to be erected, unless this initial condition of isolation be carried out in some form. At this point it is interesting to record the fact that this vital condition has become law with the Corporation of the City of Manchester, and that no new theatre in the future will be permitted to be erected without this principle of isolation to give it a *raison d'être.*

I need hardly point out that a theatre situated on an isolated site affords the architect every opportunity of securing ample and direct exit. Assuming that it is impossible to find or secure in our large English cities such fine open sites as we see in many continental capitals, and, moreover, if such sites could be found, that the cost involved would be so immense, that no theatre could be realized and maintained, unless by Municipal or State aid, let us consider what compromise may be arrived at, by which isolation of our theatres may be secured.

If fine open sites cannot be found or are impossible to the builder of a theatre in an English city, it is clear that they must in some manner be created or made. It is not necessary, for the purpose of secure and certain exit, that a building should be architecturally beautiful and imposing on all its façades (as is often the case abroad), but what I maintain is, that it should have roadways or streets of some description on all sides. These will probably exist at the front and back, but they must be made to exist at the sides. Now, how is this to be done? Either by securing land enough, or reducing the area of the building. It is only necessary that these roadways or streets should be wide enough to allow persons escaping from the theatre, access to the main thoroughfares. This expedient of creating streets was resorted to in the case of the Palace Theatre of Varieties, erected within the last few years in Manchester. On three sides of the site streets existed, and by decreasing the width of the building, a narrow street or roadway was created, and by which safe planning and direct exit were achieved. I introduce this recent instance, because, it illustrates the point I wish to maintain, namely, that it *is* possible to secure the great principle of isolation, aud consequently direct exit on all sides of the building.

Having secured an isolated site for a theatre, I will point out what I consider essential in the proper planning of entrances and exits. The primary condition is, that every part of the house, (including the orchestra) shall have at least one entrance, and one exit; this will be equivalent to two exits to each part in case of panic—as a matter of course, those persons behind the curtain must have equal provision for escape, but it will suffice to deal with the auditorium, or that portion occupied by hundreds, sometimes by thousands, of human beings. Secondly, where it is necessary for these exits to be provided with steps or staircases, they must be constructed with straight steps throughout; and if more than one flight is required, they must be built into a

centre newel wall. There must on no account be any winding or circular steps, and the maximum rise must be six inches. Furthermore, there must not be any obstruction or projecting pay-boxes on these stairs and exits; the whole must be absolutely clear, and the only openings therein must be the one at the street, and the other at the top, leading into the auditorium. Both doors in these openings must swing outwards and be provided with exit locks, which act instantly by pressure, and which are now brought to a high state of mechanical excellence.

Another condition to be insisted upon with regard to exits, is that they must be on opposite sides of the auditorium, and towards the front of the building. When a fire breaks out in a theatre, it is on the stage: self-preservation is the first law of nature, therefore, panic-stricken persons fly *from* the source of danger, and not towards it. The minimum width of auditorium staircases and exits must be fixed at five feet, with a wall hand-rail on each side. If staircases are six feet wide or more, they must be divided by a centre handrail. If the staircase is in a single flight there must be no landing of any description; these levels or broken spaces in a straight staircase are a source of danger to a panic-stricken audience. In these days of advanced fire-proof construction, it is not necessary for me to say that all exit staircases should be built of stone or concrete. I maintain, however, that the material is of no consequence as regards the safety of an escaping audience. If they are planned and arranged in the manner I have pointed out, an audience would be free of the building long before any fire could reach the means of escape.

Although the object of this paper is to treat only of safe planning, and sure escape from a burning theatre, I may be allowed to record that contingencies have arisen which have prevented an audience, or portion of an audience, from reaching the means of exit. It may be a matter of surprise to many persons to learn that the loss of life in a fire panic, in a theatre, or buildings used

for public audiences, is not owing to fire (I do not include such flimsy and quick-burning buildings as the one used for the Paris Charity Bazaar), or to actual contact with flames, but to asphyxiation, or suffocation by inhaling the poisonous gases given off during conflagration.

At Exeter, the poor creatures sitting in the gallery never left their seats, for when the cloud of poison burst from the stage, it instantly ascended, enveloped them, and left them sitting as at the play, but so many rows of ghastly corpses, instead of the merry human beings who had shortly before entered that theatre full of health and life.

This awful episode at Exeter has taught us two lessons at least: the first is, that no seat should be placed higher than the proscenium opening. It is clear that to realize this condition, a third tier is quite impossible, and in fact should never be allowed in modern theatre planning. In order to place the second or top tier as near the street level as possible, the pit must be sunk below the level of the surrounding streets. This arrangement has been carried out in the new Exeter Theatre, and in the great Theatre of Varieties, and the Comedy Theatre, in Manchester. In these theatres the dress circle is level, or nearly level with the streets, and the highest point at which any portion of the audience is placed, is twenty-three feet from the street. It may appear on first consideration of this arrangement, that to sink so large a portion of the audience is open to objection; but experience has proved that rather than objectionable, it is advantageous. The descent to the pit is achieved by inclines and steps, and an audience accepts the arrangement without demur. Moreover, in case of a stampede from panic, the chances of disaster to life are less to an ascending audience than to a descending one. I do not advocate the sinking of a whole theatre below the street level, as I believe is the case at one London theatre, because the asphyxiating fumes can only find a way out by the staircases, which would act as draft funnels, and the

ascending audiences would run the risk of suffocation during their efforts to escape to the street levels.

The second lesson we learn from the Exeter disaster is, that means should be provided for the instant isolation of the stage from the auditorium. This can now be done with ease and certainty. We have now fire-proof curtains which can be dropped, and which seal up the proscenium opening in something like ten seconds. It may here be remarked that no opening, except the proscenium one, should be allowed in the wall which divides the stage from the auditorium; the means of communication between these two parts of the building must be external, and the same arrangement applies to the orchestra. The proscenium opening being closed in, and the fire confined to the stage, with the open louvred funnel in the centre of the roof acting as a draft shaft, it is not necessary to tell anyone acquainted with the action of fire what the result would be. In the first place, the audience is safe from suffocation, and secondly, the fire on the stage will soon be under control, and great loss of property will in consequence be avoided.

As this paper is devoted to a consideration of theatre exits, I must not lengthen it by reference to other matters of interest to the architect of buildings devoted to the uses of the theatre. I must, however, point out to theatre managers that it is absolutely essential that all gangways, passages or corridors communicating with or leading to exits, should be kept open and free of extra chairs or furniture,—objects in the way of those who, panic-stricken, fly to the doors at the top of the exit staircases or passages. In any legislation connected with the building and maintenance of public buildings, neglect of this matter should be made a criminal offence.

In conclusion, I venture to think that if the safe planning I have advocated be insisted upon by properly constituted authority, the disasters of the past would be avoided, and rendered impossible in the future.

APPENDIX.

SIR HENRY IRVING'S "SAFETY THEATRE."*

The great theatre fires of 1881 and 1887 turned the thoughts of architects and public officials to a serious consideration of fire and panic-prevention in theatres, but Sir Henry Irving was the only English manager who gave emphatic expression to his thoughts on the subject by a set of plans prepared in consultation with his architect, Mr. Alfred Darbyshire, of the firm of Messrs. Darbyshire and Smith, of Manchester. These plans were published in the columns of the *Daily Telegraph* in October, 1887, accompanied by interesting notes.

The problem for solution in Sir Henry Irving's scheme involved the working out of certain absolute conditions, which may be thus briefly enumerated :—

The *initial* condition is that the theatres of the future must stand completely isolated from other property, and if suitable sites cannot be obtained, then it is hoped that the controlling authorities will forbid their erection. It will easily be seen that this condition of isolation will enable an audience to escape from all sides of the auditorium.

The *second* condition of importance is that the stage shall be instantly isolated from the auditorium by the closing of the proscenium opening. All fires originate on the stage, therefore the asphyxiating fumes must be confined to the place of their origin.

* This "Safety" Plan was adopted by Mr. Darbyshire at the new Exeter Theatre Royal, and the Palace Theatre of Varieties, Manchester.

The *third* condition is, that the highest point accessible by an audience shall be as near to the streets as possible and no seat shall be higher than the proscenium opening; this is a necessary condition in case the means of stage isolation should fail.

The *fourth* condition is, that every part of the house should be provided with two exits communicating separately and direct with the streets, and having no openings in them except at the top and bottom.

The *fifth* condition is, that the stage must have a fire-proof roof, provided with a large smoke shaft filled with glazed louvres. In case of fire (the proscenium opening being closed) both flame and smoke will at once make for this shaft. The firemen may then enter the stage and extinguish the fire.

The *sixth* condition is an important one. Every space upon which the human foot is planted in the auditorium, and escape staircases, must be absolutely fire-resisting.

The foregoing conditions apply also to those portions of a theatre devoted to the artistes and those employed behind the curtain.

These conditions will constitute a safe theatre and are realized in the plans of Sir Henry Irving's scheme.

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A Paper

BY

HUGH BONNER,

CHIEF OFFICER.

WITH

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No. 4.—THEATRE EXITS.

No. 5.—THE NEW YORK FIRE DEPARTMENT.

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NOTE.

SINCE the great Cripplegate Fire, public attention has been largely directed to the general organisation, methods and appliances of American Fire Brigades, and the establishments at New York and Chicago have been frequently referred to.

When reference has been made in this country to American Fire Brigades, the fact seems, however, to have been overlooked that these establishments influence to a large extent the prevention of fire, irrespective of their attendance at actual conflagrations.

It is in order, in the first place, to be able to present a reliable description of the New York Fire Brigade by its eminent Chief Officer, that it has been decided to publish this Paper, but at the same time, particular attention is called to those lines where the author, in a few words, clearly indicates some of the functions which fall to the lot of his department with regard to the prevention of outbreaks. We should note how to each section of his force is allotted a district of the city for which the Officer in charge is responsible, to the extent of having to superintend the enforcement of certain laws relative to the prevention of fires, the storage and sale of explosives and combustibles, alterations in buildings, exits, etc., iron shutters, obstructions to fire escapes, and even the condition of the streets and avenues. Those few lines distinctly show how much a fire brigade organised to meet modern requirements may be able to do in preventing an outbreak.

There is no necessity to remark on any of the special features of this article, excepting perhaps to emphasise the great importance which the author attaches to the various installations used in calling an alarm of fire, and the details connected with the turn-out or concentration of engines. The law of New York, by-the-bye, enforces the fixing of alarm-points to hotels, public institutions, and other important buildings particularly prone to fire risk, and many warehouses are also connected with the Fire Brigade.

In conclusion, I would say that the Committee has to thank the editor of the "Engineering Magazine," of New York for the permission to print this article, which was originally written for that journal. The courteous way in which the editor of the "Engineering Magazine" has assisted the Committee in this matter, is one of those particularly pleasant features which has marked the relations of this Committee with those interested in fire prevention on the other side of the Atlantic. The "Engineering Magazine," it should be added, takes a leading position among American journals in respect to its treatment of questions of fire protection, having for many years called attention to the serious nature of modern fire risks, and the various problems which have to be taken into consideration.

EDWIN O. SACHS.

London,
March 30th, 1898.

THE NEW YORK FIRE DEPARTMENT.

THE occurrence of a great city fire is usually, and not unnaturally, productive of the keenest interest and the most active discussion, often continuing long after new structures have risen upon the ruins of the old ones.

The property interests involved are so large, and the menace to life so great from fire in thickly-built districts, that attention is deservedly drawn to two great systems of safeguarding: first, systems of architectural construction which will make it extremely difficult for a building to take fire, or, if fire be started, to burn with rapidity; second, the most carefully organized and highly efficient system of confining and extinguishing a fire.

European cities are generally distinguished—strikingly so to an American—by the development of the former principle. In the United States, on the other hand, the chief dependence in most cases is now, and for some time must be, the efficiency of the fire department. While the heavy insurance losses on American risks and the proportionately high rates which are general, in spite of the highest organization of the protective service, suggest that prevention should coöperate with control, the recent great disaster in London has awakened active interest in the maintenance of a fire-fighting force which shall be adequate to any emergency arising in the largest cities.

It will be of interest, therefore, to study the system of organization and equipment of a typical American fire-brigade, and I shall take for an example the fire department of New York, as it existed at the end of 1897.

The fire-department of the city of New York has an aggregate of 1,146 officers and men, divided into 61 engine companies, on land, 3 companies on fire-boats, and 22 hook and ladder companies, a total of 86 companies. The number of men assigned to each varies with the

A THREE-HORSE FIRE ENGINE.

locality, but does not exceed a total of 12 (including two officers and two engineers) except in nine engine companies, which are classed as double companies, with the necessary complement of men to operate two sets of apparatus. Each section of these double companies is really a company in itself, and, in the absence of one section the other performs duty in the territory thus left vacant. The same conditions apply to one hook and

ladder company, which has a double set of apparatus, officers, and men, the second section being classed the same as the second section of a double engine company, and either assigned to cover the ground during the absence of a regular company, or held in reserve during large fires. Attached to some of the hook and ladder companies are chemical engines, which operate in the districts of the hook and ladder companies, but have an extra force in charge of them.

THE FIRE BOAT "NEW YORKER."

The department is divided into fourteen battalions, with from five to eight companies in each. The battalions are again sub-divided into three sections, and assigned to the command of a deputy chief of department, the whole force being under the direct command of the chief of department. The uniformed force consists of the following officers: chief of department, three deputy chiefs of department, one

chief instructor, fourteen chiefs of battalion, eighty-six foremen, ninety-six assistant foremen, and the necessary complement of engineers—two to each company, except in the double companies, each of which has four.

The chief of department is directly responsible for the management and discipline of the entire uniformed force and for the extinguishment of fires, and in turn is responsible to the board of fire commissioners, which body consists of three citizens, appointed by the mayor, for terms of six years each.

The duties of a deputy chief of department are to assume command in the absence of the chief of department, enforce discipline in each battalion under his charge, make inspections of the officers, men, uniforms, apparatus, horses, quarters, etc., and see that all officers are efficient in their duties.

The duties of a chief of battalion are to assume command of his battalion, regulate all the details therein, enforce discipline, visit the several company quarters in his battalion district, supervise the extinguishing of fires at which he arrives first, and forward to headquarters each morning all official papers, reports of operations at fires, etc., through the headquarters of the deputy chief to whose district the battalion belongs.

Each company has a foreman and an assistant foreman. The former is the officer in command, and is responsible for the control of his men, uniforms, discipline, etc., as well as horses, apparatus, tools, implements, and public property of all kinds entrusted to his care. He makes a return of this property annually to headquarters, and a proper record is kept. To each company is allotted a section of the city, which is classed as a company district, and for which the commanding officer is responsible. He is required to see, so far as details are concerned, to the enforcement of all laws relative to prevention of fires, storage and sale of explosives and combustibles, alterations

in buildings, exits and entrances, iron shutters, the care and condition of hydrants, obstructions to fire-escapes and their condition, the condition of streets and avenues, and every matter pertaining to the fire department. If it is not within the power of the commanding officer to correct any existing evil, he must immediately take action by forwarding the necessary reports to headquarters, with a view of abating or remedying the evil at the earliest moment. He is also required to make a

A TWO-HORSE FIRE-ENGINE.

report each morning after roll-call at 8 o'clock A.M., and to transmit the same to his battalion chief, showing the exact number of men ready for duty, those who are absent and for what cause, reports of operations at fires, etc.; and these are in turn transmitted to the deputy chief of department, and by him to the chief of department at headquarters, where all such reports are consolidated and a record kept for future reference.

Engine companies are equipped with engines of a

capacity of from 350 to 1,100 gallons per minute. The heavier engines are arranged to operate with three horses, and weigh, when ready for use, about 11,000 pounds; those of smaller size are usually located in the suburban district, do not weigh, when ready for use, more than 5,500 pounds, and, as a rule, are equipped with two horses. The engines are complete in every respect, and, while standing in quarters, are connected to a heater in the cellar, which permits a circulation between the two boilers, with the object of keeping on the engine

HAYES HOOK AND LADDER TRUCK WITH EXTENSION LADDERS.

boiler from 5 to 25 pounds of steam, which is necessary in all cases to give a prompt water-supply at fires in the vicinity of company quarters. The engines have tool-boxes containing all the tools used on pumps, machinery and boilers. Ash pans with space sufficient to carry fuel for an hour's duty are on the back of each engine.

Hose wagons are drawn by two horses, and are equipped with 1,500 feet of hose, a section of large tapering hose, two scaling ladders, life lines, life belts, life gun, life net, roof rope, wrenches, siamese, pipes,

nozzles, and hose hoisters. The hose varies in size from 1½ to 2½ inches in diameter. Hose wagons of the first size attached to engine companies carry 1,000 feet of 3-inch hose, 500 feet of 2½-inch hose, and 600 feet of

THE HAYES TRUCK, WITH LADDER EXTENDED.

1½-inch hose. The small hose is generally used at small fires, while the 3-inch hose is used on larger fires, or where more than one alarm is necessary. The wagon

carries all the men, and follows the engine to the scene of the fire. The hose wagons are supplied

SCALING LADDERS, AS USED AT NEW YORK.

with rubber hose and rubber-lined cotton-hose, and, after use at a fire, the wet hose is replaced by dry.

A hook and ladder truck of the first size is equipped with an 85-foot extension ladder, carried on a frame, with the butt resting on a turntable; the ladder is elevated by the use of cranks on each side. An aerial ladder can be elevated to a height of 85 feet in about one minute. The other ladders vary in length from 10 to 50 feet. The truck is also equipped with scaling ladders, life lines, life belts, tools and implements, such as hooks, axes, mauls, augers, saws, hammers, cellar and sub-cellar pipe, spherical nozzles, two-way siamese, four-way

HOSE WAGON, CARRYING SCALING LADDERS.

siamese, $3\frac{1}{4}$ inch hose-pipes, nozzles, roof lines, hose hoisters, ball and chain, battering ram, door-opener, wall-cutter, tin-cutter, life gun, rope ladders, claw irons, tapering hose, and fire extinguishers.

Chemical engines, which in a number of cases are in use with hook and ladder companies, are drawn by two horses, and carry two sixty-gallon tanks of fluid, resting on an iron frame. When equipped and loaded, they weigh about 5,000 pounds, and are made ready for use, when they arrive at fires, by turning the sulphuric acid

carried in a jar inside of the tank. The acid, when mixed with the soda, generates a pressure in the tank which forces the fluid through a small hose, and throws it on the fire. The water thus charged with carbonic acid gas is highly efficient in holding in check and extinguishing a fire of considerable magnitude. The chemical engines are generally used in dwelling or suburban districts, or in districts where the water-supply is scarce, or where there are not enough engines to cover the district.

Three water towers are used in conjunction with the hook and ladder companies, and are operated by an extra force of men assigned to those companies. The towers are drawn by three horses, and are constructed to receive from two to six streams of water on each side of the frame. These streams are discharged into a reservoir, and then through a $3\frac{1}{2}$-inch hose, which passes through an iron frame about 25 feet in height, and which is elevated to a perpendicular position by water pressure. There is also a 50-foot extension piece, which operates within this frame.

The streams thrown by the water tower vary in size according to the supply furnished to the reservoir, depending for this on the number of engines which can be spared for this duty. The object of this standpipe is mainly to operate in the upper part of the building; for such a situation, it affords a convenient and efficient means by which great quantities of water can be discharged when the extent of the fire warrants it. There is also a deck pipe attached to these towers, about six feet in height, connected to a similar reservoir, and fed in a like manner; it is operated from the deck of the tower by the use of a lever. Streams from this pipe can be utilized in the cellar, the top floor of a building, or may be directed toward any point of the compass, and are mainly used on the lower floors directly under the streams from the stand-pipe.

The fire boats are three in number, with capacities of

2,500, 3,500, and 13,000 gallons per minute, and are located on the East and North rivers, and at the Battery, and perform duty on the river-fronts in protecting the large piers and shipping, as well as on land to a distance of 1,000 feet from the bulkhead line. They are equipped with hose $2\frac{1}{2}$, 3, $3\frac{1}{4}$, $3\frac{1}{2}$, 4, 5, and 6 inches in diameter; there are swivel nozzles on deck and on top of the pilot house, and discharge gates on pumps from sides and fore and aft, with the necessary complement of pipes,

ONE OF THE CHEMICAL FIRE ENGINES.

nozzles, and wrenches for all sizes of hose. Two of these boats have hulls and upper bulwarks of steel, and are fully capable of entering any bulkhead or side of a pier, no matter how hot the fire. They are intended for such emergencies, as well as for removing burning vessels from their berths and hauling them to places of safety.

The boats often receive alarms for fire on shipboard, from vessels that have reached the Highland Lights, going to, or returning from, sea voyages; they go to

meet the vessels, and take entire charge of the extinguishment of the fire before the vessels reach their docks. The boats are also available for duty on either shore, when called for by the authorities. They are manned by one foreman, one assistant foreman, three engineers, two pilots, three stokers, and eight firemen.

The fire-alarm system receives at the central office all alarms from the various boxes or stations, which are marked by a red lamp. The alarm box is attached to

THE WATER TOWER, LOWERED FOR MOVEMENT THROUGH THE STREETS.

the lamp-post, and has a keyless door. On its face is a brass knob; also its number. Turning of the knob operates an automatic gong in the door, which announces to those in the vicinity that the box is being opened. From the front of the inner box a hook projects, and the pulling down of this hook once and letting it go starts the machinery in the inner box, and registers at the central office the number indicated on the face of the box. This number is immediately re-transmitted from the central office by a repeating instrument, which

transmits the signal over the various circuits to the com-

THE WATER TOWER, RAISED AND IN OPERATION.

panies which are to respond, as shown in the table on page 21.

The inner box contains a Morse key, a small armature, and a small gong. The Morse key is used when additional help is required, after the arrival of the first company at the scene of a fire. The officer in charge, if, in his judgment, additional companies are required, directs the sending of a second alarm, which is sent by Morse key from the box to the central office, the signal 2–2 being followed, say, by Station 8 6, which indicates

MANNER OF USING THE LIFE NET.

that all the companies on the second line for station 8 6 are to go to that station. Should still further help be required, a third alarm is sent, the signal 3–3 being followed by station 8 6. The 4–4 and 5–5 alarms are sent similarly. Then, if additional help is still required, the simultaneous call 9–9, station 8 6, 3–3,–3 7 9, is sent. This will bring all the companies assigned to the station at Broadway and Twenty-fifth street on the third alarm

Stations.	Engine Cos.	H. & L. Cos.	Deputy Chief of Depart.	Chief of Ba'ta'ln	Water Tower.	Company to Supply Fuel.	From Fuel Depot.	Companies to Change Locations.	Reserve Force.		
									Engine Cos.	H. & L. Cos	Ch'fs of Bat'al'n
84	27, 31, 7	8, 1	L	2, 1	1	Eng. 27	No. 3	.....	27, 31	15	4
	29, 12, 30, 13, 9	10	.....	5	...	„ 29	„ 2	.....	12, 10	6	6
*West Broadway and Worth St.	55, 6, 4, 32, 20, 24	20, 9	.....	3	...	„ 55	„ 6	E. 33 to E. 7; H. 5 to H. 1	.....	...	...
	.....	.....	.....	.....	...	.....	.....	.....	.....	...	...
	.....	.....	.....	.....	...	.....	.....	.....	.....	...	...
85	7, 31, 27	1, 8	.....	2, 1	1	Eng. 7	No. 3	.....	31, 27	15	4
	29, 12, 6, 4	10	L	5	...	„ 29	„ 2	.....	12, 10	6	6
* Church and Duane St.	9, 13, 55, 32, 30	20	.....	3	...	„ 9	„ 6	E. 33 to E. 7; H. 5 to H. 1	.....	...	...
	.....	.....	.....	.....	...	.....	.....	.....	.....	...	...
	.....	.....	.....	.....	...	.....	.....	.....	.....	...	...
86	31, 7, 12	1, 8	.....	2, 1	1	Eng. 31	No. 2	.....	31, 12	3	6
	27, 29, 9, 55, 4	10	L	3	...	„ 27	„ 3	.....	27, 33	6	7
* Broadway and Thomas St.	6, 32, 13, 20, 33, 30	20	.....	5	...	„ 6	„ 6	E. 13 to E. 7; H. 5 to H. 1	.....	...	...
	24, 17, 15, 10, 11, 25	9	.....	4	...	.....	.....	E. 18 to E. 55; H. 18 to H. 20	.....	...	...
	18, 28, 5, 14, 3	5	.....	.....	...	.....	.....	E. 5 to E. 17; E. 16 to E. 14	.....	...	...
87	7, 31, 12	1, 10	.....	2, 1	1	Eng. 7	No. 2	.....	31, 12	20	4
	27, 9, 55, 29	8	L	3	...	„ 27	„ 3	.....	27, 10	15	6
* Duane and Elm St.	4, 32, 6, 20, 13	6	.....	5	...	„ 4	„ 5	E. 33 to E. 7; H. 5 to H. 1	.....	...	...
	.....	.....	.....	.....	...	.....	.....	.....	.....	...	...
	.....	.....	.....	.....	...	.....	.....	.....	.....	...	...
88	7, 31, 12	1, 8	.....	2, 1	1	Eng. 7	No. 2	.....	31, 12	20	4
	9, 27, 55, 29	10	L	3	...	„ 9	„ 3	.....	27, 13	15	6
* Centre near Pearl St.	4, 32, 20, 6, 17	6	.....	5	...	„ 4	„ 5	E. 33 to E. 7; H 5 to H. 1	.....	...	...
	.....	.....	.....	.....	...	.....	.....	.....	.....	...	...
	.....	.....	.....	.....	...	.....	.....	.....	.....	...	...

TABLE ILLUSTRATING ASSIGNMENT OF COMPANIES, AND THER MOVEMENT ON FIRST AND LATER ALARMS.

to Worth street and Broadway, and the same course may be pursued in any section of the city where the companies are still in quarters. Companies may also be called singly by the special call signal system. When all the companies are called by the fifth alarm for station 8 6 and are on duty, the city is still protected by reserve companies, as well as those moving to various quarters. For instance, the order E. 13 to E. 7, means that second section of Engine 13, at Wooster and Spring streets, shall proceed to quarters of Engine Company 7, at Chambers and Centre streets, and cover the ground left vacant by the absence of Engine Company 7 at the fire. The order H. 5 to H. 1, means that the second section of H. & L. Co. 5 shall go to the quarters of H. & L. Co. 1, Chambers and Centre streets, and cover the district left vacant. In this manner the outlying companies are gradually brought closer to the scene of large fires, so that, in the event of one or more fires at the same time, the city as a whole has protection by the use of the reserve sections, which, as a rule, are not used at the first fire, but are held in reserve.

In addition to the street boxes, there are a number of special boxes in public institutions, theatres, hotels, academies, colleges and schools, which are in direct communication with the central office. An alarm from one of these boxes calls to the building two or more companies and a chief officer. The central office is also connected by automatic signals with a great number of mercantile houses. The law requires that public buildings, institutions, hotels, apartment-houses, colleges, etc., shall be connected with an alarm system in direct communication with the central office.

The fire alarm system south of One Hundred and Tenth street, with few exceptions, is entirely underground, the department having for its use separate conduits in the underground system. From these conduits special lines are laid to the various boxes and engine-houses throughout the city, so that, in the event

of a gale or severe snow-storm, the underground system can be relied upon in transmitting alarms.

The companies are assigned in the regular order of distance from their quarters to the locality indicated. If from any cause they should fail to arrive in such order, they are required, in forwarding their reports of operations to headquarters on the following morning, to state the cause of such failure, and also answer a set of questions. This is a record of the operations of the

INTERIOR OF MAIN FIRE-TELEGRAPH OFFICE AT HEADQUARTERS, NEW YORK.

On the left, in the background, is the key-board, each key indicating a separate circuit, on which alarms are received. The smaller instruments on the centre tables are used for transmitting first alarms to the companies assigned for response to each box. The large instrument to the left is reserved for second, third, and special alarms. Opposite to the key-board is a switch-board (not shown), by which the circuits are constantly tested.

company, and is also a part of the records of the department. The action of every officer and man on duty at an alarm of fire is a matter of record, as well as the duties performed by the companies, and a copy is sent to the headquarters daily. The responsibility in

all cases commences with the first officer arriving, who must assume command of the fire until the arrival of a superior, who in a like manner assumes command until relieved by someone higher in authority.

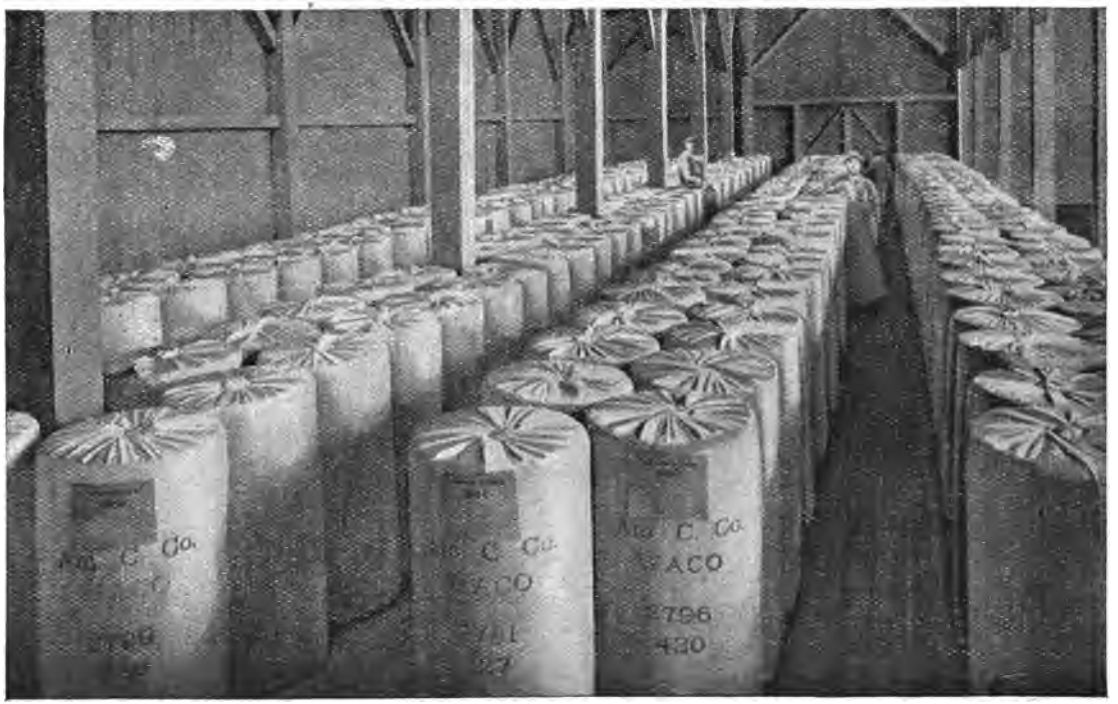
The water is supplied by the reservoir system. Large conduits are run through the main avenues, and from these points distributed to the smaller mains throughout the city. To these smaller mains are connected the fire

FIRE ALARM BOX WITH INNER DOOR OPEN.

hydrants which supply the engines with water. The hydrants are of several patterns. Those that are now being set for use are of an improved type, and very seldom freeze, being connected to a sewer which permits the superfluous water from the barrel to pass into the sewer after the valve is closed from the main. Those of the old pattern freeze every winter, so that the engineers, on arriving with their engines, have to open the hydrant

to see if it is frozen. If it is, the engineer immediately applies the thaw hose, connected to the boiler of the engine, and uses the steam and hot water from the boiler to thaw out the hydrant, which usually takes about five minutes. When the water is found, the connection is made, and the engine is ready to force water through the hose stretched from the engines to the fire. Many of the streets are still using the six-inch mains, which give a sufficient supply for an ordinary fire, but, when more than the usual number of companies are drawing water from this main, it is entirely inadequate. Many streets are supplied with mains from 12 to 48 inches in diameter, which obviate in a measure the defects of the smaller mains. In the districts where the larger pipes are located there is never a scarcity of water. Since the introduction of the new aqueduct, the supply has met every requirement, even at extraordinary fires.

Spare engines, with men, are detailed to thaw out all hydrants found frozen, and these hydrants are then salted, turning any water remaining in the barrel into a strong brine. This course is followed during each cold spell throughout the winter.



THE STORAGE OF "ROUND" BALES.

Publications of the

BRITISH FIRE PREVENTION COMMITTEE.—No. 6.

Edited by Edwin O. Sachs.

COTTON FIRES & COTTON BALES.

A Paper

BY

R. H. SCOTTER, C.E.

WITH

Illustrations.

LONDON, 1898.

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No. 6.—COTTON FIRES AND COTTON BALES.

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OBJECTS:

The main objects of the Committee are :—

To direct attention to the urgent need for increased protection of life and property from fire by the adoption of preventive measures.

To use its influence in every direction towards minimising the possibilities and dangers of fire.

To bring together those scientifically interested in the subject of Fire Prevention.

To arrange periodical meetings for the discussion of practical questions bearing on the same.

To establish a reading-room, library and collections for purposes of research, and for supplying recent and authentic information on the subject of Fire Prevention.

To publish from time to time papers specially prepared for the Committee, together with records, extracts, and translations.

To undertake such independent investigations and tests of materials, methods and appliances as may be considered advisable.

The Committee does not hold itself in any way responsible for the opinions expressed, or methods advocated, by members and others who kindly contribute to these publications.

Comments on the opinions expressed in these papers, or further information on the subjects under consideration, are cordially invited by the Executive, at whose discretion they will be circulated among the members of the Committee.

NOTE.

THOUGH general rules may be laid down for the protection of warehouses from fire as far as their construction is concerned, there is no doubt that for the storage of particular goods, specific measures are essential. Thus, the cotton warehouse requires peculiar care as regards subdivision of risks, the position of windows facing south, ventilation, and many other matters which tend to prevent self-ignition on the one hand and the rapid spread of fire on the other.

But frequently it is impossible to obtain a practical minimum of risk by attending to questions of structure and equipment only. We have to go further and consider whether the goods are packed in a safe manner, and whether without disturbing the ordinary course of business and without incurring undue expenditure, the risk involved by using unsuitable forms of package or by careless handling can be reduced without inconvenience to the trade.

Now, it has been long recognised that, as far as cotton warehouses are concerned, one of the primary dangers is to be found in the actual packing of cotton. And as the cotton warehouse is one of those buildings that has been most liable to destruction by fire, it has been thought advisable here to give a hearing to those who argue that a better form of bale would do much both towards reducing the risk of outbreak and the risk of a fire spreading when once alight. In the paper before the Committee, we find strong advocacy of what is termed the "round" or "cylindrical" bale as compared with the far clumsier and certainly more dangerous "turtle-backed" bale which is now commonly in use. As to the greater practicability of this new bale from a fireman's point of view, I think there can be little

doubt; but it rests entirely with those associated with the cotton trade, to decide whether the use of this bale does not involve some extra expenditure or inconvenience. There is no doubt that the old bale tends in every way to facilitate an outbreak of fire and its spread, and though it will be seen that the energetic measures in force at Liverpool since the cotton fire epidemic of 1892 and 1893 have tended to lessen materially the number of conflagrations, it yet remains a fact that when an outbreak takes a hold of a cotton warehouse where the "turtle-backed" bale is used, the destruction of property is not only very rapid but also very complete.

Should there be no practical nor economic reason against the introduction of a different bale for the purposes of Liverpool and other centres interested, I certainly hold that the old bale should be done away with, to make room for a safer form of cotton package. It might be well if any conservatism or mere prejudice against the innovation were overcome by some enforcement of its adoption within a certain number of years. It may not, however, be politic for local authorities to define the form of cotton package in the same way as definitions are made in respect to explosives or highly inflammable liquids; yet where the public authorities leave such matters optional, any substantial rebate afforded by the insurance companies on a particular form of package should certainly induce a voluntary modification of what is at present a most dangerous and clumsy form for consigning a very valuable article of commerce.

EDWIN O. SACHS.

London,
April 25th, 1898.

Cotton Fires and Cotton Bales.

In order to appreciate the importance of adequate fire preventative measures in cotton warehouses, it is necessary to point out the enormous extent of the cotton trade in Liverpool. In the early days of the growth of the cotton manufacture, Manchester, South-East Lancashire, and North Cheshire seemed marked out by Nature as its ideal situation. An abundance of running water, a damp climate, and the presence of an industrial community assisted among other causes to make Manchester what it is to-day. Now at least three quarters in value of the raw cotton imported for use in South Lancashire comes from the United States of America, and of this amount all but a very small proportion passes through Liverpool. Liverpool, it must be remembered, is a port of transit, as owing to various causes it is not possible to manufacture the cotton there. It is, however, warehoused for some time pending delivery to the mills inland. In 1896, the total weight of cotton imported into the United Kingdom was 15,668,900 cwt. valued at £36,272,039; of this amount 12,446,000 cwt. valued at £27,965,000 came into the country from the United States. The total imported into Liverpool amounted to 13,384,000 cwt. This arrived from the following countries, America, 2,900,688 bales; Brazil, 72,996 bales; Egypt, 398,954 bales; West Indies, 46,560 bales; East Indies, 58,126 bales.

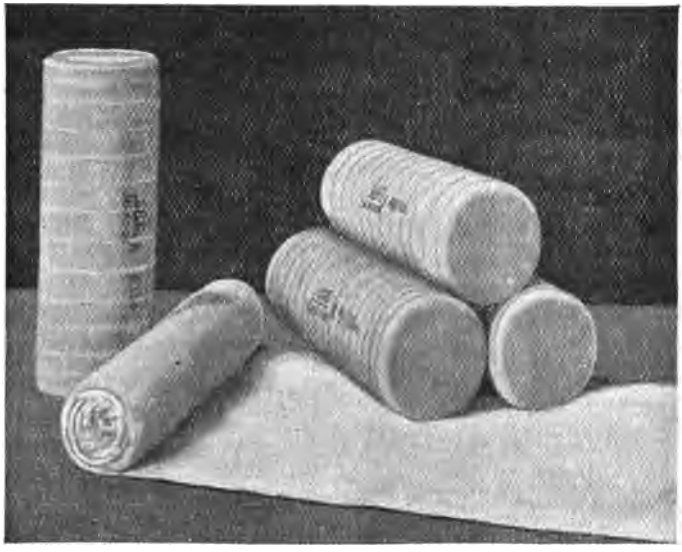
It generally happens that a considerably greater quantity is imported than can be disposed of to the manufacturers, as for instance, at one time, March 24th, 1898, it was estimated that 1,175,439 bales were stored in Liverpool warehouses, 1,073,535 of which were bales of American cotton. This gives some idea of the warehouse accommodation necessary, and also some idea of the value of the "risks" involved.

A few years ago, 1891–2 Liverpool seemed to be suffering from an epidemic of Cotton Fires: on one day, June 13th, 1892, no less than three serious fires happened and the Fire Brigade was kept continuously at work for twenty-seven hours. The cause of most of these fires could, however, not be discovered. In 1892–3 matters eventually became so serious and the destruction of property so enormous, that the Salvage Association offered substantial rewards for evidence regarding the origin of any outbreak, more particularly as to the carelessness (if any) of employés. These rewards resulted in it being proved that a great number of Cotton Fires were the result actually of carelessness on the part of warehousemen. A hot pipe, a match thrown away unextinguished, or sparks from a lighted tobacco pipe, have no doubt been the immediate cause of much of the loss. It was seen that one of the first remedies would have to be the appointment of several special Fire Inspectors, and the rigid application of the rules as to smoking, open lights, etc., with the enforcement of which they were entrusted. The benefits of this action may be seen from the following figures, showing the number of Cotton Fires occurring in Liverpool. The decrease of fires after 1892-93 is most marked.

Before Action was taken.		After Action was taken.	
1890-1893.		1894-97.	
1890	14	1894	10
1891	13	1895	3
1892	32	1896	4
1893	18	1897	6

It is also interesting to note the value of property at risk at actual fires since 1893. Taken roughly, the value of buildings and contents at stake was as follows:—

	Stock.	Buildings.
1893 ...	£771,625 ...	... £54,892
1894 ...	194,845 ...	... 22,556
1895 ...	28,600 ...	... 3,866
1896 ...	97,850 ...	... 11,155
1897 ...	88,776 ...	... 17,500



THE "ROUND" BALE.

Setting aside the actual cause of fire by open light, self-combustion or otherwise, the spread of an outbreak is primarily due to insufficient packing and inadequate compression.

Now it is a remarkable fact that nearly all the damage by Cotton Fires in Liverpool only affects American Cotton, though the aggregate of bales from other countries is quite one-fifth of the total quantity shipped to that port. Egyptian and Indian Cottons are very seldom

affected in the great Liverpool conflagrations. This is largely due to the fact that the latter classes of bales are more securely and densely packed before being shipped to Europe, and to my mind no really successful attempt can ever be made to lessen the extent of a Cotton Fire while raw Cotton is packed in the United States in the present unsuitable manner in bales of the "turtle-backed" description. The old American bale is produced in a compress which masses together under a sudden pressure of 2,000 tons per bale, cotton fibre, sand, and unfortunately any amount of foreign matter which dishonest or careless packers may see fit to introduce. During the process it is impossible to exclude an appreciable quantity of air. This air and the foreign substances already mentioned as present in the bale together constitute, on a rise of temperature, two sources of concealed danger against which ordinary preventive measures are applied in vain. Added to these dangers from within, there is also the danger of the inefficient outer covering, as the bales are generally only sewn up in coarse jute. This jute is in itself highly inflammable, but it also allows the Cotton to get through, with the result that the outer surface of a bale is fluffy and only too easily catches fire. Again, the size, weight and shape of these bales necessitate many processes during transportation which considerably add to the risk of fire. In loading and unloading a free use of hooks is made and these are responsible for the ragged condition in which bales arrive at the warehouse or mill. It is this extra raggedness which again assists the spread of flames.

Anyone who may have witnessed the commencement of a Cotton Fire and seen the lightning rapidity with which the fire spreads along the warehouse floor will appreciate the great danger from these ragged ends.

The "waste" occasioned by the ragged bales makes the floors literally a tinder line, and with even the most careful of sweepers the floors cannot be kept clean where the "turtle-back" bale is used.

Recognising the great necessity there is for a different system of packing cotton if we are to take steps towards preventing Cotton fires in the future, I shall try to briefly describe how the new style of bale is made which is at present attracting the attention of the Cotton world, and the makers of which claim that its adoption will materially reduce the risk from fire to which cotton is at present exposed.

This so-called "round," or more properly speaking the "cylindrical" bale is produced by a new Hydraulic Press. The cotton coming from a gin, just touches the underside of the condenser wheel or drum and is immediately deposited between the two aprons of a bat former; the air and dust pass out through the meshes of a wire cloth above. The two aprons of the bat former carry the cotton down, gradually compressing it, and the bat then passes between a compression roll and a stationary roll. A solid bat of cotton is thus formed which again passes on to a bale now being formed between the two main compression rolls. The pressure on the bale is produced by an hydraulic cylinder and as the bale increases in size, it regulates automatically the pressure required. By an ingenious contrivance the pressure can be regulated up to a maximum of 200 lbs. per square inch.

The standard "round" bale produced is cylindrical, weighs 425 lbs., is 4 feet long, 2 feet in diameter, and its density is about 35 lbs. per cubic foot, or 50 per cent. more dense than a best compressed bale on the old system; although the average pressure exerted in making the "round" bale is only about 10 tons, as compared with 2,400 tons in making the "compress" bale.

As the tendency of modern fire prevention methods is to reduce, rather than increase, the storing capacity of each separate room in the warehouse, this advantage as to bulk is important. The Liverpool Fire Prevention Act grants the maximum of 4,000 sup. feet for warehouses, 6,000 feet for sheds of two floors, and 7,000 square feet for ground floor sheds only. As an example

of what may be done in packing these bales in a small space I may mention that in December, 1896, the largest single truck load of cotton ever carried was conveyed by the Illinois Central Railway in a box truck, the bales being made on the "round" bale system. It consisted of 160 bales and weighed 68,628 lbs.

Now the principal feature of this bale in relation to fire prevention is that it is claimed to be both fire-and-water-proof. It is formed in a short space of time and not left about the yard to pick up dirt, sand or wet; it contains no compressed air; it is much better packed and secured, and is not only less liable to self-ignition, but should the warehouse or shed in which it may be stored be attacked by fire we have ample proof from theory, from experiment, and from practical experience, that this form of bale resists the attack of fire admirably. Various experiments have been made in placing a "turtle-back" and a "round" bale on the same fire. In favour of the former it may be said that should a fire have worked its way into a bale before it is discovered a dash at the bands with a hatchet will release the cotton and allow water to be thrown on the burning spot. On the other hand the "round" bale would have to be unwound in a similar contingency. But it must be remembered that it is denied that a fire can penetrate a "round" bale, and if a non-inflammable covering be used in the packing, no doubt this risk will be reduced to a minimum.

An interesting experiment was made last year in Liverpool, where a cylindrical bale and an ordinary bale were both exposed to the same fire. After half an hour the fire was extinguished and the bales rolled off. The old bale fell off with bands complete, but the new bale became unrolled in the process of removing it from the furnace and the cotton blazed up. However, only a small portion was found to be alight, and this was extinguished in a few seconds, while the cotton in the old bale was still burning next morning. Prior

to the test the old bale weighed 410 lbs., of this, 261 lbs. of sound cotton was obtained after the fire, showing a loss of 36·3 per cent., while the "round" bale, which weighed 504 lbs., lost 22·2 per cent. or 112 lbs. by damage from the fire.

This shows in favour of the new system and taking into account the greater density of the cotton, and under recent improvements the non-combustibility of the Hessian cloth, chemically treated, with which it is suggested all cylindrical bales should be encased, the latter have a decided advantage in the matter of fire prevention.

But leaving experiments which have been carried out in the interests of Insurance Offices, both in this country and America (with the result that the offices have reduced the premium on round bales by one-half), I will just mention a fire which occurred in the Rock River Cotton Co.'s works at Janesville, Wisconsin, in July last year. The official report says "the main building with machinery became a total loss. The Cotton, some 40 round bales, which was lying where the fire was the hottest and could not be reached until after the building was entirely burned out, was entirely saved. When found, only the covering was gone and about an inch of cotton scorched, the rest of the cotton perfectly dry, white and wholly uninjured. The bales with ends cut, opened as well as if they had never been burned. The water had not penetrated any at all." This latter statement is, perhaps, of primary importance, for it is well known how often more damage is done to the cotton by water than by actual fire. To repeat, I hold that the spread of a cotton fire can only be limited by giving more attention to the packing of bales, which not only governs the extent of the spread, but the extent of the salvage after the fire. As the expense of improved bales is often argued, I would only add that, as a matter of fact, what with the easier porterage, reduced insurance rates and other economies which the new bales allow

for growers, shippers and merchants alike, their introduction means a material saving to all concerned, quite independent of the lesser risk, which should count for something, considering the inconvenience generally caused by fire loss, no matter how well goods may be covered by insurance.

In conclusion I would give a short list of some of the most disastrous Liverpool cotton fires in recent years. The figures indicating the losses are of course only taken approximately:

1883	April 21st	Lancelots Hey	£100,000
1884	May 17th	Chapel Street	£100,000
1886	Oct. 25th	Hornby Dock	£70,000
1886	Oct. 31st	Wellington Dock	£35,000
1887	Nov. 10th	Hornby Dock	£35,000
1888	July 26th	Sandon Dock Shed	£70,000
1888	Sept. 5th	Bootle	£40,000
1889	July 19th	Grundy Street	£70,000
1889	Aug. 10th	Bootle	£25,000
1890	July 29th	Dacre Street 2,500 bales	
1891	May 12th	Formby Street	£40,000
1891	Oct. 21st	Toronto Street	£90,000
1892	Jan. 18th	Vulcan Street, 3,800 bales	
1892	June 13th	Huskisson, 3000 bales	
1892	June 13th	Bath Street	£100,000
1892	June 13th	Brook Street	£20,000
1892	Dec. 17th	Burrells	£40,000
1893	Mar. 26th	Studholme Street	£18,000
1894	Feb. 10th	Effingham Street, 4,600 bales	
1894	Aug. 4th	Atlanta Road	£40,000
1895	May 22nd	Irland Road	£40,000

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Edited by Edwin O. Sachs.

"FIRE-RESISTING" FLOORS

USED IN

LONDON.

A Paper

BY

FREDERIC R. FARROW,

FELLOW OF THE ROYAL INSTITUTE OF BRITISH ARCHITECTS,

WITH

Illustrations.

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OBJECTS:

The main objects of the Committee are:—

To direct attention to the urgent need for increased protection of life and property from fire by the adoption of preventive measures.

To use its influence in every direction towards minimising the possibilities and dangers of fire.

To bring together those scientifically interested in the subject of Fire Prevention.

To arrange periodical meetings for the discussion of practical questions bearing on the same.

To establish a reading-room, library and collections for purposes of research, and for supplying recent and authentic information on the subject of Fire Prevention.

To publish from time to time papers specially prepared for the Committee, together with records, extracts, and translations.

To undertake such independent investigations and tests of materials, methods and appliances as may be considered advisable.

The Committee does not hold itself in any way responsible for the opinions expressed, or methods advocated, by members and others who kindly contribute to these publications.

Comments on the opinions expressed in these papers, or further information on the subjects under consideration, are cordially invited by the Executive, at whose discretion they will be circulated among the members of the Committee.

NOTE.

THOUGH architects are no doubt conversant with many of the different forms of construction employed by various makers of "fire-resisting" floors, the very large variety of methods and materials at the disposal of the Metropolis does not appear to be generally recognised.

It is in order to indicate what kinds of floors are at the disposal of architects that this paper has been prepared, but it will be seen that every effort has been made to carefully avoid anything that might be construed as criticism in regard to their merits. For such criticism would be obviously out of place in a publication of this description, in which it is in no way the purpose to either commend or depreciate the work of individual makers, but simply to summarise what is available. It will rest with the architect to judge which of the many forms of construction meets his requirements as to fire-resistance and cost, but even as regards the forming of any opinion he will have to go generally by hearsay, for until independent tests with the materials and forms of construction have been duly taken in hand, he will have but few scientific facts to consider. Such tests alone, if so arranged that only the enumeration of actual facts shall be given, will make it possible to determine absolutely as regards the specific suitability of the different floors for particular purposes. Scientific and independent tests can alone give us a clue as to the policy that should be adopted in the construction of different classes of building.

There is little in a building that calls for so much attention as the construction of a floor, and yet, as I have said, the great variety of floors at our disposal is scarcely recognised, nor have we any absolute data to go on as to the purposes they can fulfil.

This paper should tend to show us the means we can make use of, but until tests have been taken in hand this paper must remain a mere enumeration of what is at our disposal.

That the preparation of such a list, however, involves considerable trouble, it is needless to remark. But what certainly must have given the author more trouble than the collection of particulars, is the presentation of facts without any indication of likes or dislikes. This avoidance of criticism, I believe, the members of the Committee will be the first to appreciate.

It is to be hoped that this small summary will be of use to those who either design and carry out buildings, or are entrusted with their control.

EDWIN O. SACHS.

London,
May 4th, 1898.

PREFACE.

IN the preparation of this paper the author has thought it well rather to give a descriptive account of the fire-resisting constructions used for floors in London, than to attempt to criticise or express an opinion as to the comparative merits of the various methods that have found exemplars in London buildings. Many of the floors described have no doubt been exposed to the action of a real conflagration, but any satisfactory or unsatisfactory results thus obtained are not necessarily conclusive. Scientific tests alone afford a fair basis for judging of the merits of a floor or its suitability to fulfil specific purposes. As will be seen from the descriptions and illustrations given, there are many good methods of construction now in use, but it can by no means be said that the last word in the designing of fire-resisting floors has yet been spoken. New materials and new combinations are also being constantly discovered and devised. Fuller knowledge must yet, however, be obtained by experience of the behaviour of various materials, under such trying ordeals of exposure to fire and water as they are intended to endure. Finality can, therefore, in no sense be as yet expected in the designs of fire-resisting floors until we have more definite information to go upon. But undoubtedly progress, and satisfactory progress, is being made, and when we have the real facts before us we may expect rapid developments in the general introduction of improved forms of construction.

FREDERIC R. FARROW.

7, NEW COURT, LINCOLN'S INN,
April, 1898.

"Fire-Resisting" Floors used in London.

In the earliest forms of "Fire-Resisting" Floors used in London, the aim of the inventors seems to have been simply to provide a floor of non-combustible material, and for a very long time the importance of preventing damage to the incombustible components of fire-resisting floors was wholly neglected; but, at the present day, it is almost needless to point out that it is quite as important that the construction of a "fire-resisting" floor should be such as to obviate the possibility, or at least the probability, of damage occurring to the building by failure of the floor in several other directions besides that of combustibility. A "fire-resisting" floor to be of any reliable value must not permit of any part of its construction being melted, distorted, or broken by the action of the heat of the fire, or by the water used in quenching the fire, nor must there be any possibility of damage by expansion or contraction of the various constituents of the construction under the greatest extremes of heat and cold to which it may be exposed.

The importance of avoiding damage by expansion and contraction militates against the employment of some otherwise admirable materials. It also renders it imperative that all metal work shall be preserved, not only from the direct action of fire, but also from the convection of any considerable amount of heat by such

protective sheathing as may be incorporated in the construction of the floor.

Perhaps the earliest attempt at the construction of "fire-resisting" floors was the employment of a series of iron girders supporting brick arches which rested upon the upper surface of the flanges. In some of the very earliest examples, the girders were of cast iron, but the system was continued subsequently with rolled iron joists. Those who used this form of floor evidently felt that there might be some possibility of trouble arising from the thrust of the arches, and therefore in some cases wrought iron tie rods were inserted below the level of the brick arches. The result could hardly be otherwise than disastrous; the girders and tie rods were exposed to the full action of both fire and water, and the failure of one girder meant, of course, that of the arches supported by it, which necessarily would be speedily followed by the collapse of the whole floor from the thrust of the remaining arches. Such an unsatisfactory method of construction may now, we hope, be relegated to the limbo of forgotten ineffectiveness. The use of unprotected iron girders for supporting incombustible construction of various kinds remained, however, the common practice for a very long time; and although suggestions were made for adequate protection of the iron many years ago, it is but quite recently that this has been generally regarded as a *sine quâ non* in the design of a satisfactory "fire-resisting" floor.

The varied forms of "fire-resisting" floors which have been devised may be classified into those which do not attempt complete protection of the iron work, those which do attempt complete protection of the iron work, and those in which endeavours are made to dispense with ironwork or, at least, iron joists altogether. In each of these classes we have a sub-division into those forms of construction which require temporary centreing, and those which provide their own centreing or have a permanent centreing.

There are but few examples now in use of "fire-resisting" floors which do not attempt some protection of the iron work, although in several instances the protection consists only of a suspended ceiling.

"Fire-resisting" floors, in which a permanent centreing is used are constructed with curved sheets of corrugated galvanized iron resting upon the upper surfaces of the lower flanges of the iron joists with concrete filling-in above this centreing.

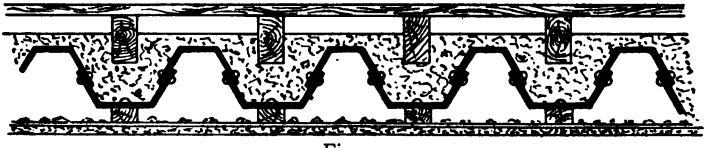

Fig. 1.

Messrs. William Lindsay and Co's Floor, shown in Fig. 1, of steel decking with concrete filling-in above, is a floor designed with the view of weight-bearing capability. The under surface of the steel decking and the lower flanges of the joist are unprotected. The concrete used is pumice concrete, that is, it is composed of coke breeze, sand, and Portland cement. Where protection to the iron is desired a suspended ceiling can be applied as shown.

Passing on to the consideration of those floors which attempt complete protection of the ironwork, and taking

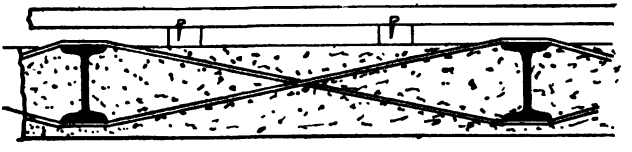

Fig. 2.

first of all those which require temporary centreing, we have a group in which the ironwork is wholly embedded in solid concrete. Of these, Lindsay's system with interlaced tension rods passing over and under the iron or steel joists is illustrated in Fig. 2. The concrete is in this case pumice concrete.

Messrs. B. Ward and Co. have constructed floors under their patent for a steel webbed solid concrete floor, in which the steel webbing passes over the top of the iron joists, and so is embedded in the lower half of the thickness of the concrete. This was one of the earliest forms of floor in which the idea of increasing the tensile strength of concrete by means of embedded metal was adopted.

Messrs. W. B. Wilkinson & Co. have also made floors of solid concrete with the joists embedded and the tension iron rods passing over the top of the joist.

Fig. 3.

The Stuart Granolithic Stone Company make thin floors in granolithic concrete, with the steel joists embedded in concrete blocks, and using central beams also of granolithic concrete, as shown in Figure 3. Floors in granolithic concrete have also been constructed in arched form with thin crowns and thickened haunches.

Another group of floors is that in which flat arches between the joists are used, provision being made for the protection of the under side of the joists on which the arches rest.

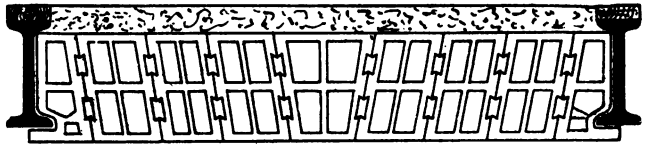

Fig. 4.

Of constructions of this kind we have examples in the Doulton-Peto floor, illustrated in Fig. 4, in which the arches are built in fire-clay blocks with dovetailed sinkings on the sides to form a key for the cement. Another example is Messrs. Blanchard's floor, in which perforated blocks are used, tied together with iron rods

passing through the joists, as shown in Fig. 5. Similar in principle to these are Burnett's floor, Hornblower's, and Northcroft's; whilst Whichcord's system, with solid fireclay blocks enclosing the lower part of the joists and forming the skewbacks of the arches, may be taken as the parent of these systems of construction.

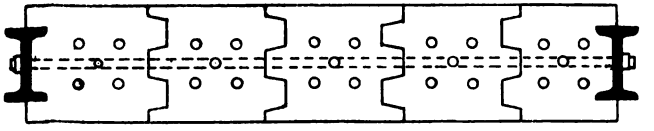

Fig. 5.

The United Terra Cotta Co. use arched forms in flat arches similar in principle to those already described in the Doulton-Peto, and cognate systems. The essential feature is that the material of which the hollow blocks are composed is a very light and porous earthenware, obtained by mixing the clay with sawdust before burning.

The more modern examples in this section are to be found in a group, of which Banks' Floor and the floors made by the Expanded Metal Company are the best illustrations. In Banks' Fireproof Floor the steel joists

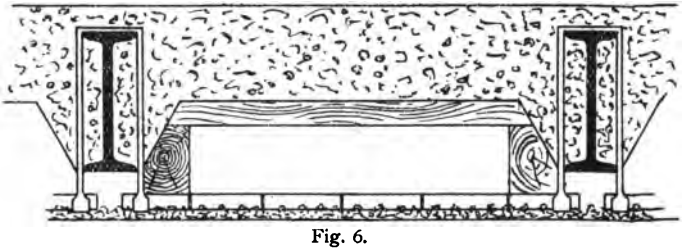

Fig. 6.

are wholly embedded in the concrete, excepting the under-side of the lower flanges, and these are protected by the suspended ceiling hung from the top of the steel joist. This floor is shown in Fig. 6, with the wood centreing in position, for the removal of which the hangers to the ceiling are hinged.

The Expanded Metal Company use their patented material as the basis of several varying forms of fire-resisting floors. The expanded metal lathing is generally embedded in the lower part of a concrete slab to

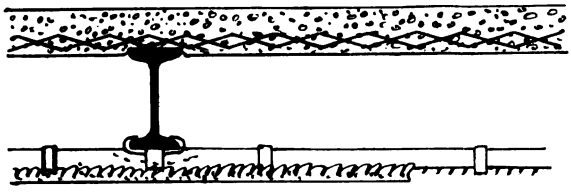

Fig. 7.

which it therefore imparts, as do other arrangements of embedded metal, the tensile strength in which simple concrete is deficient. In most of the methods adopted by this Company, the concrete slab with the embedded metal lathing is above the joists (as shown in Fig. 7), which are protected by being embedded in concrete, cased around with metal lathing and plastered or shielded by a suspended ceiling. In other instances the joists are themselves embedded in the concrete slab, the metal lathing being placed either below or between the joists. Additional strength for the concrete slab is in some cases provided by arched ribs of channel iron and concrete, either with or without a suspended ceiling.

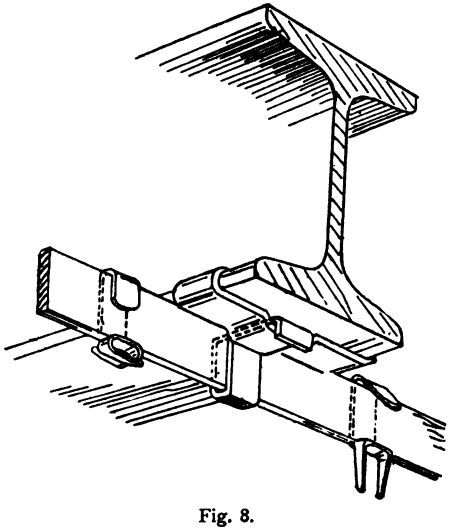

Fig. 8.

The hanging arrangement for the suspended ceiling is shown in Fig. 8, the wire lathing being attached to the thin bars by the clips shown. An example of a floor with the joist cased is shown in Fig. 9.

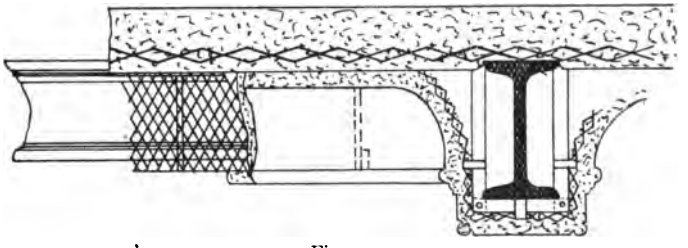

Fig. 9.

Of floors in which a permanent centreing is provided or of which the construction of the floor is independent of any temporary centreing, there are a large number of examples that attempt complete protection of the iron or steel joists. In the majority of these floors the lintel principle is adopted in construction rather than the arcuate.

Of these the Fawcett floor is a typical example, the special feature being that the hollow tubular earthen-

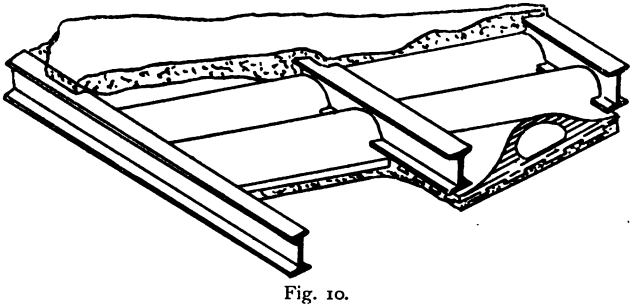

Fig. 10.

ware lintels are arranged diagonally, their own diagonals being at right angles to the line of the joists. The advantage sought by this method is to enable the lintel to cover more completely the under-side of the lower flange of the joist. These tubular lintels form the

centreing for the concrete which is filled in above as shown in Fig. 10.

Messrs. C. G. Picking & Co.'s interlocking floor is similar in some respects to the Fawcett, but each lintel has two tubes, and projections are arranged at the side to afford the means of interlocking. This is shown in Figs. 11 and 12.

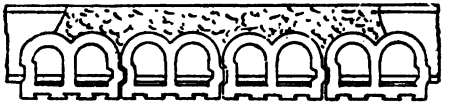

Fig. 11.

The Shepwood patent floor is an arrangement of flat terra cotta slabs grooved at the edges and fitted to the flanges of small T iron bearers, which span the distance between the joists. Special blocks are made to cover the lower flanges of the joists and thus a complete permanent centreing for the concrete is formed.

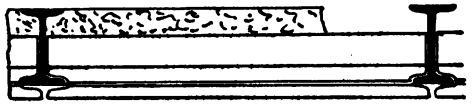

Fig. 12.

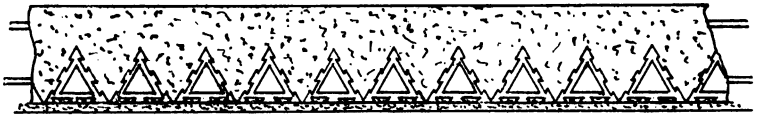

Fig. 13.

In the most modern type of Messrs. Homan and Rodger's floor, triangular lintels are used, passing from

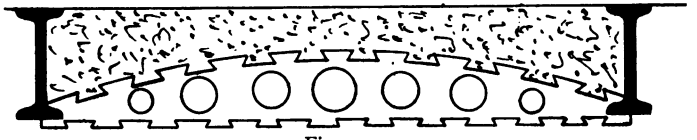

Fig. 14.

joist to joist and resting on the lower flange, the under surface of which they cover. This form is illustrated in Fig. 13, whilst an older type is shown in Figs. 14 and 15.

Messrs. Aston & Son construct a floor, which as will be seen from the illustrations, Figs. 16, 17, and 18, is a

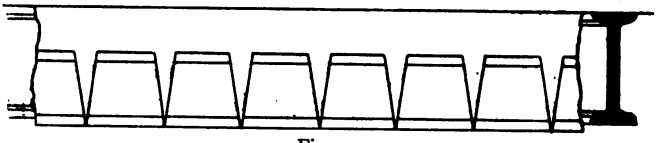

Fig. 15.

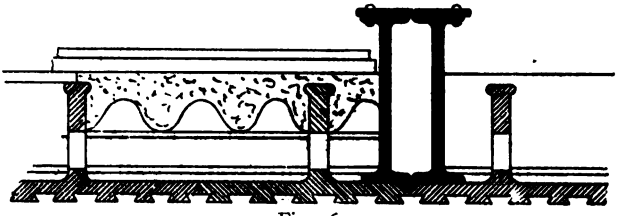

Fig. 16.

combination of flat lintels of T section and corrugated iron permanent centreing. This floor was formerly

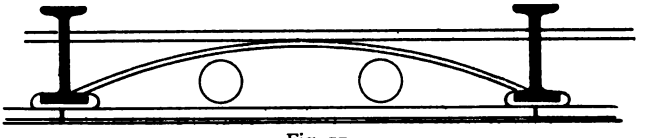

Fig. 17.

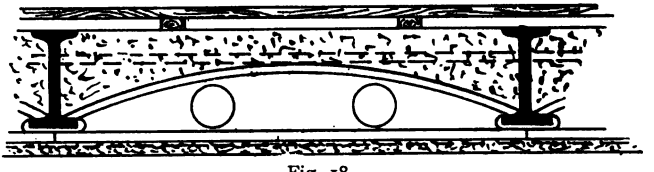

Fig. 18.

carried out by Willis & Astley, the preceding holders of the patent. Messrs. Aston & Son also construct

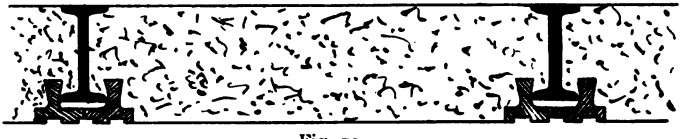

Fig. 19.

floors of solid concrete with terra cotta casings to flanges, as shown in Fig. 19. This latter form of floor of course

requires temporary centreing. In Fig. 17, the floor is shown without the concrete, but in Fig. 18 the completed floor is drawn.

Messrs. Potter & Co.'s floor, as illustrated in Fig. 20, is a combination of several ideas. The lower flanges of the joists are protected by clay shields which support

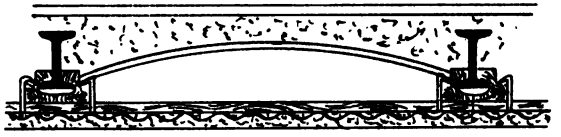

Fig. 20.

corrugated iron permanent centreing for the concrete, and in addition there is a suspended ceiling of wire lathing and plaster.

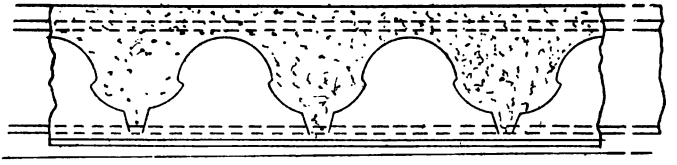

Fig. 21.

Another example of the lintel system is the Adamant Cement Company's Floor, in which the lintels are

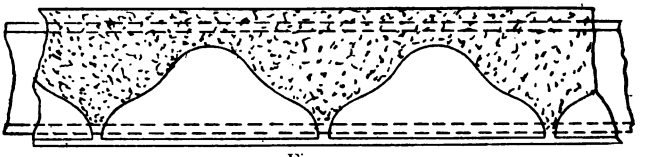

Fig. 22.

formed of concrete blocks composed of Adamant cement with breeze or other aggregate, and sometimes strengthened by the insertion of steel laths. On these lintels is laid a concrete filling. The lintels are slightly varied in form, one shape being shown in Fig. 21, and another in Figs. 22 and 23.

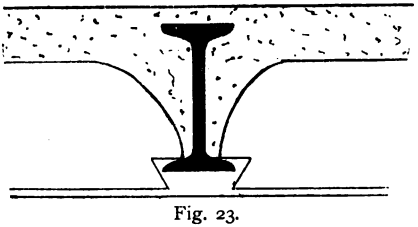

Fig. 23.

Approximating somewhat to the lintel form are the floors known as the Mulciber and the Carlisle. The former of these, as will be seen from Fig. 24, consists of

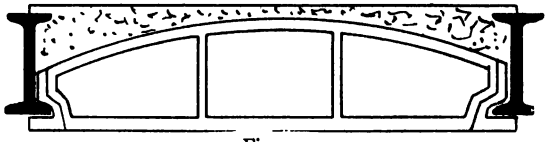

Fig. 24.

loose fireclay blocks, enclosing the flanges of the joists and forming corbels, on which rest the hollow fireclay lintels, serving as the permanent centreing for a slight finish of concrete. The Carlisle consists of two hollow tubes between each pair of joists, and the filling in of concrete, of which there is a very small amount,

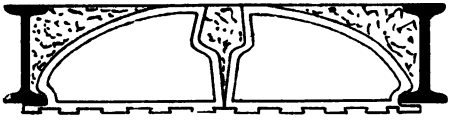

Fig. 25.

forms the key between the tubes. This is illustrated in Fig. 25. A somewhat similar floor to the Carlisle has been made by Messrs. Picking & Co., as shown in Fig. 26.

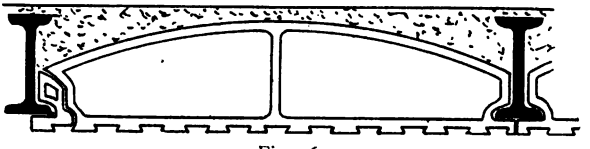

Fig. 26.

In Messrs. B. Ward & Co.'s system of cellular tubes between the joists, as illustrated in Figs. 27, 28 and 29, the especial feature is that the cellular slabs or lintels are formed of gypsum, this being in small pieces.

For domestic buildings and where no great weight is to be carried by the floors, or where the floors are of small spans, various forms of fire-resisting floors are in use which are specially intended to fulfil these

particular conditions. As examples of these we have concrete slabs with expanded metal or other lathing, Edwards' Floor of concrete slab with iron rods, and several other similar constructions. There is also the method of using wood beams set diagonally so as to form skewbacks for the reception of concrete arches or slabs.

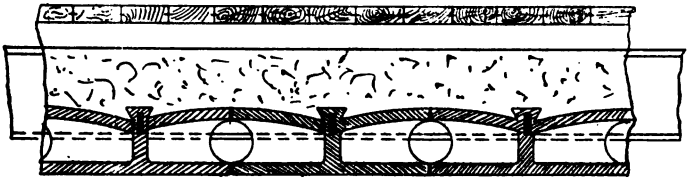

Fig. 27.

A method of considerable antiquity, but now very little used, is that in which a floor sometimes flat but more often arched in section, is constructed of plain roofing tiles, and in 3 or 4 courses laid in cement and breaking joint, with or without a finish of fine concrete on top. This method has been largely used for corridors and other situations where the floors are of no very great span.

"Fire-resisting" floors formed of wood have been introduced, such as Evans and Swain's, which consists of ordinary wooden joists nailed together side by side, thus forming a practically solid floor of wood.

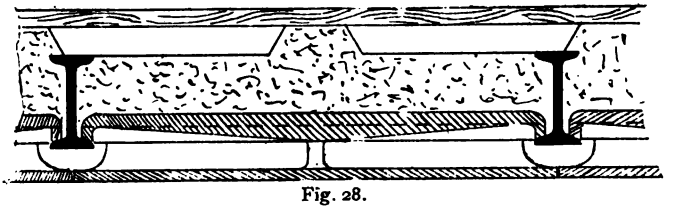

Fig. 28.

A newly patented floor is Hinton and Day's, in which the space between ordinary floor joists is blocked in solid with wood at the lower part of the depth of the joists. A layer of concrete is sometimes added.

Another class of floors intended to provide a moderate amount of protection or "fire-resistance," includes those

in which the ordinary construction of wood-joisted floor is supplemented by pugging on fibrous plaster slabs as carried out by Messrs. Wilkinson, or pugging laid on metal lathing without rough boarding and nailed to the under-side of the wood joists.

A modified form of Messrs. Ward's cellular gypsum slabs, already referred to above, has been used for affording protection to the under-side of an ordinary wooden joisted floor.

The protection of ordinary wooden joisted floors is carried out also by various combinations of special fire-resisting plasters, and various forms of special lathing.

Amongst these special plasters may be mentioned Asbestic, Fibrous, Silicate Cotton plaster; Adamant cement, and Robinson's cement.

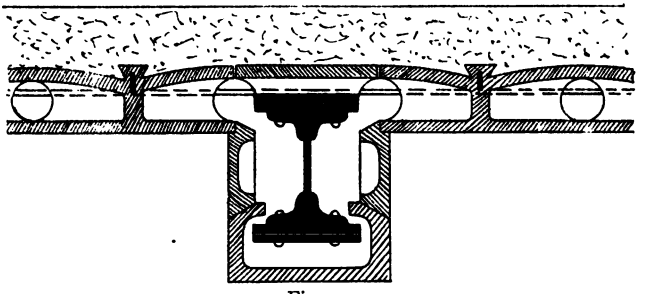

Fig. 29.

Amongst the special Lathings may be mentioned the Expanded Metal already referred to, and Banks' Helical Lathing, in which flat ribbons are interlaced in lattice fashion but twisted between their interlacings.

Jhilmil is a metal lathing in which flat sheets of metal are cut and bent up and down to form projecting strips, thus forming a metal lathing with space for keying.

There is also a fire-resisting lathing recently introduced by the Mural and Decoration Syndicate, made of woven iron wire studded at its intersections with terra cotta.

Mention must be made of concretes of special composition for the purpose of resisting fire more thoroughly

than ordinary concrete. One of the first introductions of this nature was the gypsum concrete of Messrs. Dennett and Ingle.

A more recent introduction is the Boyd-Wilson patent concrete, in which "Kieselguhr" is used on account of its low conductivity.

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FIRE STATION AT THE STANDISH COMPANY'S WORKS.

Publications of the

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Edited by Edwin O. Sachs.

FIRE SERVICE

IN

Factories, Works, &c.

A Paper

BY

HAROLD SUMNER.

WITH

Illustrations.

LONDON, 1898.

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OBJECTS:

The main objects of the Committee are:—

To direct attention to the urgent need for increased protection of life and property from fire by the adoption of preventive measures.

To use its influence in every direction towards minimising the possibilities and dangers of fire.

To bring together those scientifically interested in the subject of Fire Prevention.

To arrange periodical meetings for the discussion of practical questions bearing on the same.

To establish a reading-room, library and collections for purposes of research, and for supplying recent and authentic information on the subject of Fire Prevention.

To publish from time to time papers specially prepared for the Committee, together with records, extracts, and translations.

To undertake such independent investigations and tests of materials, methods and appliances as may be considered advisable.

The Committee does not hold itself in any way responsible for the opinions expressed, or methods advocated, by members and others who kindly contribute to these publications.

Comments on the opinions expressed in these papers, or further information on the subjects under consideration, are cordially invited by the Executive, at whose discretion they will be circulated among the members of the Committee.

NOTE.

QUESTIONS relating to the fire service of a factory, a mill, or a similar establishment, as the case may be, receive as yet but scant attention. There is, however, at the moment, some feeling that more importance should be attached to the subject, and that there are considerable advantages to be obtained by avoiding that constant neglect of precautionary measures which has been so common.

It would, perhaps, only have been natural when dealing with the fire service of a factory, to see the words of advice from some prominent fire brigade officer, or from some expert closely associated with the technical aspect of the subject. But after due consideration, and well recollecting the prejudice with which expert advice is so frequently met, one could not fail to acknowledge that if the words of advice came from one actively engaged in the management of an establishment of this description, the manufacturer or mill owner, as the case may be, would perhaps be more prone to recognise that there exist concerns in which the question of fire protection is not only kept well in mind, but where some one member of the firm in question gives the matter sufficient attention to be able to control the precautionary measures with a considerable knowledge of what is actually required.

Mr. Sumner has very courteously taken upon himself this *rôle* of an adviser to his *confrères* in factory management. He writes as one who full well knows that no insurance money can make good the inconvenience and loss of trade generally occasioned by a fire.

He has been at pains to see that the establishment with which he is associated does not suffer from neglect, and at the same time he has so far made himself conversant with the points at issue that he is now able to lay down certain facts which should be particularly useful to others placed in similar positions to himself.

Much that Mr. Sumner says is of the most elementary description, but it is the elementary fact that is so essential where the constant neglect of questions of fire protection has also involved the complete ignorance of modern requirements. However elementary some of Mr. Sumner's words may sound to the reader who has some knowledge of the subject, such a reader may be assured that, for many, the entire contents of this paper are practically a new field.

Coming, as they do, not from an expert, I trust Mr. Sumner's words may be of use to those to whom they are primarily directed, *i.e.*, to those who have charge of going concerns. We have before us words of advice from one who has adopted precautionary measures with the conviction that these measures are in the interests of his business. They should be read as such.

EDWIN O. SACHS.

LONDON,
May 26th, 1898.

Fire Service

IN

Factories, Works, &c.

IT is difficult to generalise on a subject of this description. No two factories have the same requirements in the matter of fire service. And yet most factories have so much in common that I will attempt to show what is necessary for an establishment worked under normal conditions and of an average extent.

For the purpose of this paper I assume that the factory or works under consideration covers several acres; that the water supply is ample, either from reservoirs, river, or canal; that there is no fire brigade within reasonable distance; that there is no public water supply, and that the "risk" is an average hazard. It is assumed that the buildings are of fairly substantial type, mostly only one storey in height, but not constructed with particular regard to avoiding damage by fire or with any special attempt to separate the various hazards.

Now, the first consideration is the description of the plant to be adopted, and before entering further into this matter it is desirable to point out that quite as much care should be taken in choosing the best apparatus as if the selection of some additional machinery for the process of manufacture were in question. Only apparatus by first-class and reliable makers should be chosen.

The principal part of the fire-extinguishing apparatus is the pump, be it a stationary one or a portable steam fire engine. This pump we will call the fire pump, and remark that it should be preferably a stationary one. Its position should be carefully chosen, both as regards the distance from the main water supply and the boilers which are to supply it with steam. It is advisable that the fire pump be exclusively bought and used as such, and beyond occasional employment as an auxiliary or stand-by to the general pumping plant of the works, it should not be brought into daily and regular use, but be solely retained for its specific purpose. It must not be understood by this that it is to have no attention paid to it, and stand idle month after month; on the contrary, it should be worked regularly at stated intervals, tried for lengthy and short spells under the conditions it would be required for, and occasionally be thoroughly overhauled.

The reasons for having a pump stationed for fire purposes only are, firstly, that it would probably be found to be an uneconomical pump for general purposes; and, secondly, that, provided it has proper attention bestowed on it, it is always ready for immediate use without time being lost in changing from some other work it may be performing. The type of pump I consider best adapted for this work is one of the duplex type, *i.e.*, having two steam cylinders and two water cylinders, steam and water cylinders being on the same rods. This type has the advantage of starting immediately and dispensing with a fly-wheel. The water-way should be large and so arranged that the water, when passing through the pump, has no devious paths to follow. It should be brass-lined throughout the water end, and of strong construction. Large suction and delivery air vessels should be provided, and also a bye-pass between the delivery and suction chambers, so as to enable the pump to work with small or large jets. For deep lifts the suction pipes should be provided with a foot valve,

and where possible with a charging pipe and valve. Hose valves can also be conveniently provided so as to permit of two or more jets being directly obtained from the pump.

In ordering such a pump it should be carefully specified that the pump shall be able to work efficiently and well with a low, as well as a high, steam pressure. This is essential, since the steam pressure is often low at night time or during any stoppage of the works. It must also be taken into consideration that the quantity of water stated to be delivered by the makers is generally the maximum possible under the most favourable conditions.

The fire pump should be housed in a building of its own, preferably detached from any other, but as near its steam supply as possible. In factories, where steam is not kept up during the night or during holidays, it is advisable to have an auxiliary boiler placed near the fire pump. This boiler should then be of a quick steaming type, similar to those used with steam fire engines, and it should be possible to raise steam to 100 lbs. pressure in eight minutes. In such cases, of course, the fire pump should be connected with the main boilers as well as with the auxiliary boiler, so that the steam supply from the former, if available, can be primarily utilised.

The fire pump should be directly connected with the principal system of fire mains. Where it is possible the delivery into the mains should be effected through a T-piece delivering into two mains, each running in different directions from the fire pump, but joining at the most distant point, thereby forming a complete circuit round the premises. Each main should have a controlling shut-off valve in the pump house, so that it can be used independently of the other.

Valves should be placed at various convenient points on the mains to permit the speedy cutting off of any section that may be rendered inoperative through a

burst, without the whole system of mains being necessarily thereby affected. The mains should be large, and should be laid at least two feet six inches below the surface. Cast iron spigot and socket pipes, coated internally and externally with Angus-Smith's solution, should be used in preference to flanged pipes, though the latter are useful when any alteration to the mains may be expected to frequently occur. All the pipes should be carefully tested before being laid. Easy bends in the directions of the flow of the water should be provided, and every precaution taken to minimise loss of pressure through friction in the pipes. Branch circuits can be taken off the principal system for special sections of the works or for circuits of secondary mains, such as the internal ones, and dead-ends should be avoided. A flush-out pipe controlled by a valve should be provided for flushing out the mains periodically, or for emptying them in cases of severe frost. The latter valve, of course, would be placed at the lowest point of the mains, so that the mains could be quickly and efficiently emptied.

An automatic water-relief valve should be placed on the main close by the fire pump, and, further, one or more valves of this description should be placed on the mains. This precaution will obviate any damage to the mains or fire pump from shocks occasioned by the simultaneous or sudden shutting-down of the hydrants in use.

The course of the mains should not be laid too close to the buildings, but some few feet away, without being so placed as to be liable to be damaged by heavy traffic passing over the hydrant boxes.

The position of each hydrant or standpost off the main system should be clearly indicated by a plate on the wall immediately over the hydrant. The hydrants should be placed in near proximity to or opposite the entrances to different parts of the works, and should be so arranged that at least four jets are easily capable of

being brought to bear on any given point. The hydrant boxes should be lined with cement and drained. Special precautions should be taken against frost either by the adoption of "frost-proof" hydrants, by keeping the fire mains empty during the cold weather, as indicated above, or by ensuring in some way a gentle and constant flow of water throughout the system. It should be strictly prohibited to deposit anything on or in close proximity to a hydrant.

In connection with the main system generally, simply known as the external fire main, a series of internal mains, each forming its own circuit, can be arranged. A shut-down valve should be placed at the points of connection between the external and internal mains, so that the latter can be easily cut off from the external mains should they be damaged or rendered useless during the progress of a fire. The position of these valves should also be clearly indicated. This system of inside mains should run through every part of the factory. Each room or section of the works should have one or two fire valves off these internal mains, the hydrants being situated near the entrance to the room or section.

Quite apart from the water supply and pressure obtainable through the fire pump, it is advisable that the whole of the mains (internal and external) be connected either with an overhead tank, situated on a roof and holding at least 6,000 gallons, or to a public supply main.

This tank, or public supply, will always keep the mains, external and internal, charged with water under a slight head, and be found useful for a rapid first attack on any outbreak discovered in its early stages. This slight head may suffice to extinguish a small fire or keep the flames in check till the main pump can be got to work. A valve should be placed in a convenient position on the rising pipe to the tank; this valve is to be closed when the fire

pump is at work, so as to avoid any loss of pressure or water on the system of mains.

It is important that a large-sized tank should be employed when a constant steam supply is not available, and this tank should be of sufficient capacity to ensure a plentiful water supply till steam is raised in the quick-steaming boiler mentioned before. Automatic starting valves can be placed on the steam supply pipe of the pump, in order to start the pump directly any water is drawn from the mains, but this device, of course, can only be adopted when a constant steam pressure is obtainable. Where the reservoir or other source of water supply furnishes sufficient head to keep all the mains under a moderate pressure at the highest point of the system the tank can be dispensed with.

Neither the external or internal fire mains should be used for the ordinary supply purposes of the factory, if it can be avoided; and, where it is necessary, all connections must be securely made, so as to stand the pressure necessary for an efficient fire service.

As to the hydrants and valves, these should be of the best make, of gun metal throughout, and of such construction that they are not liable to leak and are easily and quickly opened. Near each fire valve or cock a cupboard or box, containing sufficient hose to reach to any point of the protective area of the fire valve, a branch pipe, and a proper sized nozzle should be provided. This cupboard should be damp-proof and provided with glass doors, so that it can at once be seen if the proper appliances are in good condition. Instead of the cupboard, the hose and branch pipe can be flaked on a swivel bracket, or attached to the wall, but in damp places the cupboard is preferable. If the hose is kept directly attached to the valve, a small tap or cock should be placed between the seating of the valve and the hose coupling. This tap should be kept partially open, so that any water leaking past the valve will be

drained away, preventing any deterioration of the hose and calling attention to the faulty state of the valve. A tap can be placed on the main itself for the purpose of filling the fire buckets, etc. It is advisable to provide an air vessel of large size, or a water-relief valve, to each circuit of internal mains, and also a few cut-off valves in a similar way and for reasons similar to those mentioned when speaking of the external mains.

As the internal mains are of undoubted utility in preventing the spread of a fire or checking it in its inception, it is advisable that the fire valves and mains should be as numerous as possible. The size of the internal mains generally depends on the size of the room or part to be protected, but the greater proportion of the internal mains should not be less than four inches in diameter. But with all due regard to the value of the internal main or circuit, the external main should always have precedence, owing to possibility of working from it in more than one direction, or, in other words, owing to its greater elasticity. It should also not be forgotten that internal mains are liable to damage during a fire, and may thus cause the outside mains to be inefficient until the necessary stoppages have been effected.

For this reason, too, should the question ever arise of protecting a factory by external *or* internal mains solely, and not by a combination of the two, then the external main should be chosen without hesitation, and any internal protection must be supplied by means of hand-pumps, and so forth.

Roof hydrants are of undoubted utility where access to the roof is easy. These hydrants can be furnished either by the prolongation of an internal rising main or by an exterior rising pipe in connection with the external main. Where iron fire escape landings are provided for the escape of employés in two or more storied buildings, fire valves can also be placed off such

roof mains at different levels in proximity to these landings.

In choosing positions for the roof hydrants, their accessibility and range of working utility should be carefully considered. Shut-off valves and drain taps should be placed in convenient positions so as to prevent damage by frost.

Where it is necessary or desirable to have two fire pumps, each with a separate system of mains, a connection between the two systems of mains should be made, in case either of the fire pumps break down or be otherwise out of service.

All underground valves should be placed in cement-lined, well-drained, brick chambers, with easily removable covers, and have a specially lettered plate fixed to a wall in close proximity.

It is also advisable so to arrange the piping that one or more of the pumps in the factory can, if required, pump into the fire mains to afford auxiliary aid.

Smaller appliances, such as buckets, hand pumps or chemical "extincteurs," can be judiciously distributed about the works. The buckets should be painted red, or some distinctive colour, and should always be kept three-quarters full of water. A few drops of glycerine spread over the surface of the water in a thin film, will materially prevent evaporation. Workpeople should be distinctly forbidden to use these buckets for any other purpose than extinguishing of fire.

A hand pump in conjunction with the buckets will be found of more utility than the small chemical "extincteurs." The "extincteurs" have the advantage that they can be called into instant use, but, even then, present in this respect no real advantage over a hand pump and two or three buckets full of water. On the other hand, "extincteurs" require a certain amount of special knowledge as to their use, and necessitate frequent examination. Moreover, as the charges are comparatively expensive, frequent trials or use for

instruction purposes are seldom thought of, and, further, they present the great disadvantage of being quickly exhausted and requiring considerable time for recharging. "Hand grenades," it should be added, are generally useless unless in the hands of specially-trained men fully conversant with grenade throwing.

In chemical laboratories, a box of slightly moist sand should be kept handy for dealing with outbreaks of fire where water cannot be successfully employed.

The other accessories, such as branch pipes, stand pipes, and so forth, should be of the best type and sufficient in number. The couplings should be preferably the same as those of the nearest fire brigade, and all accessories should be of the same size and type throughout the place. A certain number of ladders should be stored at a given place, and be of such a size that access to the roofs can easily be obtained.

In addition to the stationary fire pump and system of fire mains, or in place of them, it may be found desirable to have either a manual or a steam fire engine, or both. Either of these appliances will be found useful in case of a break down of the fire pump, or steam and water main, and especially in those establishments where steam is not always kept up day and night throughout the year. The initial expense of these appliances will probably be found less costly than a thoroughly efficient system of mains and a fire pump, though the latter have many advantages, the most obvious of which is the fact that the water can be supplied by hydrants at any convenient point required —irrespective of the distance from the main water supply, and under a better head than could be obtained by pumping through long lines of hose from either a manual or steamer.

Provided that a fairly good public water main supply is obtainable, a steamer or manual, in conjunction with a reservoir or river, is a useful addition to a fire protective plant.

These engines should be placed in a well-ventilated room or station of their own, conveniently situated for quick "turning-out," and for easy access to the different parts of the buildings. They should be kept scrupulously clean, in thorough working order, and provided with the necessary gear. They should be so arranged that they can be taken by hand or horse draught to any desired spot.

A steam fire engine is to be preferred to a manual owing to its greater power and ease of working.

A supply of boiling water should be constantly kept for the boiler of the steamer either by means of a gas jet or heater. With some instruction it will be found that any intelligent mechanic can efficiently take charge of the steam fire engine.

In order, however, to work the fire appliances efficiently—no matter if they take the form of mains and hydrants, fire engines, or both—it is advisable to form a body of trained men who have a thorough acquaintance with the fire protective measures and appliances at the disposal of the works or factory in question. This body of men should be known as the Works Fire Brigade, and its members should be picked men residing in the near vicinity of the works.

It is advisable that the Brigade be a relatively large one, so that the services of a certain number of them can be relied upon during the stoppages of the works. The officers should be chosen from amongst those having authority in the works, and the whole placed under the direction of one of the superior officials or heads of the firm.

The men should have the proper clothing and helmets supplied to them, and every effort made to make the members feel that the Brigade is one of the valued institutions of the establishment.

It is perhaps more satisfactory that the men be remunerated for drills than that their services be voluntary. The remuneration is a useful lever for the

maintenance of proper discipline, and is in many ways a more efficient system than a voluntary one combined with some special benefit such as an annual dinner or excursion. The paid system, further, need not, and should not, exclude any such special benefit as a dinner or outing for the men of the Brigade.

The Brigade can be divided into companies or sections, each in charge of a foreman. Each company should have its special duties in case of an outbreak of fire, one company having charge of the stationary fire pumps and the maintenance of the steam and water supply, whilst another has charge of a steam fire engine. The whole organisation should, however, be under the command of one chief officer, who would be responsible to his employers.

The Brigade should be drilled regularly, and every member should be made acquainted with the working of *all* the different appliances, hydrants, water sources, and so forth, no matter what special section he may be attached to. The drills should have special reference to the buildings they are primarily expected to protect.

A certain number or all the men may also be conveniently instructed in ambulance work. An ambulance corps is of great utility in any works for dealing with the accidents which unfortunately take place from time to time, but for fire brigade work the possibility of obtaining "first aid" on the spot is essential.

The fire appliances throughout the works should be inspected weekly by some responsible officer of the brigade and a report made to the chief, who would have to verify these reports from time to time. This weekly inspection should not be of a perfunctory nature, but a thorough examination of all pumps, hydrants, valves, etc., about the place, and any defect should be promptly repaired. A special report book with the necessary headings should be kept and signed by the officer charged with this inspection. In this report book a record of all tests should also be kept and it should

shew when the appliances were last thoroughly overhauled. All appliances should be cleaned and every hydrant flushed out once every week under the supervision of the inspecting officer. To avoid friction with the heads of departments, etc., the internal appliances can be put under the charge of the respective foremen of rooms or shops, but these foremen should be made responsible for their being kept clean and in good order, and the appliances should, nevertheless, be regularly inspected.

The engines and appliances at the fire station should be in the charge of one or more firemen especially told off for this duty, and would also be subject to regular inspection.

The fire alarm can be given by means of a steam whistle when steam is always kept up, or by means of a bell. The whistle should be of a distinctive sound, and not the same one which calls or dismisses the workpeople. The fire whistle should occasionally—once or twice a week—be blown at pre-arranged times, preferably at the middle of the day and simultaneously with the works whistle, in order to keep it in thorough working order. It can be placed either on the watchman's room, the central office, the fire station, boiler house, or other recognised building. In large establishments it is, however, better to have a supplementary system of electrical fire-calls communicating from the different buildings to wherever the whistle may be placed. Where an establishment covers a very large area, there can be more than one whistle.

The watching service or patrolling of the works as a precautionary measure against outbreaks of fire, is a most important feature of any system of fire protection. This precaution of watching is now practically always undertaken at every factory of any size, and it often constitutes the sole fire preventative measure. The system can be elaborated according to the size and the risk of the premises in which it is employed. In other

than very large establishments, it is generally performed by the night watchman, who must be a trustworthy, active, and resourceful man, and have a thorough knowledge of every part of the premises under his care, of the position of the fire appliances, their nature, and the resources generally at his command. It is of paramount importance that the patrolling is systematically carried out, and that every part of the works or factory, however insignificant, receives a regular visit from those appointed to this duty. It is therefore necessary that some means be adopted to ensure that this duty is satisfactorily carried out. Surprise visits are of value, but some mechanical or electrical system of recording the visits of the watchman to the various points of his rounds, are very desirable. The use of peg clocks or control watches will be found to meet this desideratum The control watch is carried by the watchman, and its distinctive feature consists of a strip of paper round the inside of the watch ; the strip is graduated or subdivided into hours, half hours and quarter hours. Each room or determined point is provided with a case affixed to the wall containing a special key attached to the case by a chain. Each key makes a separate and distinctive mark on the strip of paper, showing the time the watchman inserted the same into the watch. The strip on its removal in the morning gives a faithful record of the various points visited, the route taken, and the time of each visit to the different parts of the works. By a judicious distribution of the keys and a determination of the route to be taken so that every part of the works must be patrolled by the watchman, satisfactory results are obtainable.

Where more than one watchman is employed on night service, one should make his rounds while the other remains in the watchman's office ready to attend to any emergency. The system of electric fire calls from various points of the works or factory, and communicating to the watchman's office or fire station, can be

usefully adopted in this case. The watchman not on patrol can receive the call and immediately give the alarm.

The number of men employed, and the system adopted for night watching, must of course depend on the size of the establishment. In very large works it may be found desirable to have one or two members of the fire brigade sleeping at the fire station, and in addition it may be necessary in day time to have one or more men ready for any emergency, and solely employed as watchmen or firemen. The close proximity or otherwise of the members of the Works Fire Brigade should be taken into consideration when determining the question of night or day watching service. Part of the Fire Brigade can keep their uniforms at the station, and part at home, so that no time is lost either by day or night in securing a number of properly equipped men. The day men and night men should be changed every month.

In a factory the risk of fire is always present to a certain degree, quite apart from any special risk in the process of manufacture, on account of the carelessness of those employed on the premises. It is, therefore, essential that this factor be taken into due consideration.

Smoking is generally severely prohibited, but the necessary attention to the use of matches, where gas is used as an illuminant, is mostly overlooked.

The lighting of the gas jets should be solely in the hands of those especially appointed to this duty.

Electric gas igniters, or special gas lighting lamps, should be employed, and both the ignition and the extinction of all gas lights should be performed by the same men.

Wire guards should be adapted to all unenclosed gas jets, and the supply pipes made of galvanized iron.

Similar precautions apply to electric light fittings, only those who are duly authorised should be allowed to switch the light off or on at the main switchboard or

distributing boards. Any tampering with the fittings; should be strictly prohibited.

The accumulation of oily rags or waste must be guarded against. A special receptacle should be supplied for these, which should be emptied periodically. Proper oil-catching tins should be provided on all engines, shafting, and the like, and the reprehensible practice of putting down sawdust to catch the oil drippings absolutely forbidden. Not only is the oil-soaked sawdust highly dangerous, but this method of catching oil dripping is wasteful in the extreme.

By the use of suitable tins, the waste oil can be collected, filtered, and used again.

Accumulations of dust or lint on the steam pipes or boilers is to be avoided.

Where a steam pipe passes through a wooden partition, the hole through which it runs should be of considerably larger diameter than really necessary, so as to permit a current of air passing between the pipe and the woodwork. Should this not be admissible, asbestos packing should be placed between the pipe and the timber. On no account should steam pipes be placed on, or in close proximity to woodwork without some special precaution being taken to prevent any ignition of the latter. The covering of steam pipes to prevent condensation, as universally carried out, greatly minimises the risk of fire.

Wooden partitions should be avoided as far as possible.

Stacks of wood or timber yards should be placed at a safe distance from any building. Special precautions must be taken in the storing of easily inflammable substances such as oils, paints, etc.

Fire-resisting doors should be placed at all openings in party walls or other dangerous positions. Iron doors are not to be recommended, they are heavy and unreliable, owing to their tendency to warp or buckle when exposed to great heat. Doors made of two or three thicknesses

of timber, covered with lap-jointed sheets of tinned steel, are in every way preferable to the solid iron door.

"Fireproof" shutters can be usefully employed in certain cases, but care must be taken that the entire window framing is fire-resisting.

The sprinkler system, though of comparatively recent growth, is now extensively employed in factories, and particularly in cotton spinning and weaving mills. The sprinkler consists of a valve with a half-inch opening, which is kept closed by means of a strut or other mechanism. A fusible solder is employed in one or more parts of the sprinkler. This solder melts at a given degree of heat and opens the valve, which allows the water to fall on a serrated plate, thereby distributing a fine spray or rain over a comparatively large area. The sprinkler is thus automatic, the heat resulting from an outbreak of fire bringing it into immediate action. The pipes to which the sprinkler are attached and from whence they obtain their water supply, are fed either by an overhead cistern which must be at least 15 feet higher than the roof of the buildings the sprinklers protect, or by an automatic self-starting pump. Two distinct water supplies are required for a sprinkler installation, viz., a combination of tank and pump, or a public supply main and pump or tank. Sprinklers, however, have now been brought to a state of great perfection, and are generally considered reliable fire extinguishers.

A modification of the ordinary sprinkler is the "drencher" sprinkler. This is an open sprinkler or valve placed on an empty pipe, the water supply being controlled by a valve which is opened on an outbreak of fire. The object of this type of sprinkler is to form a sheet or wall of water to prevent the flames passing from one building to another either through a door or windows, and can be used to protect the whole frontage of any building in danger from a fire raging in its neighbourhood.

The Factory Acts require that special provision be

made for the escape of work-people in case of fire, and, further, reasonable provision has to be made for the escape of all persons on storeys above the ground floor.

In every factory or workshop erected after January 1st, 1896, the doors of each room in which more than ten persons are employed must, except in the case of sliding doors, be made to open outwards.

When the question of extending or altering existing premises arises, it is advisable that considerable attention be given to any constructional features that may be dangerous from a fire preventative point of view, and above all that separation of hazards should not be forgotten. The employer should never forget to consult the officer in charge of his fire service before starting any constructional work and his opinions should have due consideration.

In conclusion, it may be considered that the protective measures mentioned in this paper may entail too considerable pecuniary outlay. The question of expense should not serve as an excuse for negligence. It must, of course, not be overlooked that the case here taken is that of a factory thrown on its own resources. It is, however, advisable, no matter how good or efficient the external help in case of fire may be, that every factory or works should take into consideration the necessity of being prepared for emergencies, whether the necessary installation adopted be a small or a large one. And where an installation is once provided, there should be every effort made to ensure proper attention being bestowed to the maintenance of a high standard of efficiency.

An effective, well-planned, and carefully inspected fire-protective plant will immediately repay any expense when the moment of urgency arises.

Those firms (and there are many) which have already given this matter their serious consideration, keeping efficient fire brigades and installing the necessary fire-extinguishing plant, have had no reason to regret their outlay on such precautionary measures.

VIEW OF THE STANDISH COMPANY'S WORKS.

APPENDIX.

Fire Protective Arrangements at the Works of the Standish Company, Ltd., Worthington, near Wigan.

The water supply for the works comprises two reservoirs containing 3,000,000 gallons and 400,000 gallons respectively, with daily supply of 750,000 gallons. There are also a river and some brooks, and a minor reservoir.

There is a double acting high speed stationary fire pump, duplex type, with steam cylinders 14 inches in diameter, water cylinders 7 inches, and 8-inch stroke. Capacity, 800 gallons per minute. This fire pump is housed in a separate building in close proximity to a range of boilers, and can take its water supply from either of the two main reservoirs. It feeds two 6-inch cast-iron mains forming a complete circuit round the works. It is fitted with byepass, relief valve, and hose couplings, and is kept ready for instant use.

The external 6-inch mains feed 26 hydrants, the position of which is denoted by wall plates. Each hydrant is placed in a cement-lined brick chamber which is drained. Each main is controlled by a valve in the fire pump house, sectional cut-off valves being also provided. The piping is so arranged that in case of breakdown of this pump, two boiler feed pumps can be utilised, giving a delivery of about 500 gallons a minute.

There are several internal mains connected with the external mains by means of valves which are controlled outside the buildings. The internal mains are 4-inch cast-iron flanged pipes and are connected with an overhead tank about 35 feet high, carried on four walls and containing 24,000 gallons of water. This tank is fed from a third and smaller reservoir by a direct-acting pump and supplies various parts of the works with water. The tank can be promptly cut off from the system of fire mains when the fire pump is in operation. The pump supplying this tank, which is situated in the centre ot the works, can be used for fire purposes and fire valves are provided therefor. Fourteen internal fire valves are provided, each having a sufficient quantity of hose and branch pipe in close proximity. Buckets, chemical extincteurs, hand pumps, etc., are distributed throughout the works where necessary.

The fire station—36 feet long, 25 feet broad, and 15 feet high—contains one steam fire-engine of double-acting vertical type of

300 gallons capacity, kept in readiness for instant use; also a hose-cart, manual engine and ambulance-cart, 1,000 yards of hose, eight stand-pipes, twelve branch-pipes, scaling ladders, fire ladders, lamps, and a complete set of minor accessories, such as smoke-jacket, nozzles, etc. A constant supply of hot water is kept, and all engines are arranged for manual or horse draught.

The fire alarm consists of a steam whistle of the syren type, and is controlled from the outside of the fire station. At night time a red electric light is also displayed when the alarm is sounded.

A sub-station is situated at the opposite end of the works, and contains hose, stand-pipes, branch-pipes, hand-pump, buckets, ladders, etc. A coal supply for the steamer is also kept at the main fire station and near the sub-station.

The fire brigade consists of thirty members, inclusive of officers, and is divided into sections of five men, each in charge of a foreman. One section has the control of the pumps, water and steam supply, in case of fire. The brigade is uniformed, and all members live on the firm's property, or in close proximity to the works. All drills are remunerated and take place fortnightly.

Twelve members of the brigade keep their uniforms at the station, the remainder at home. Every month these twelve men are changed. The brigade also attends fires in the district when required.

The nearest available town brigade (volunteer) is five miles distant.

The Works ambulance corps is composed of members of the fire brigade.

All fire apparatus throughout the works is cleaned once a week. All fire valves and hydrants are inspected and tested weekly. Written weekly reports are made concerning the good maintenance and condition of all appliances connected with the fire protection of the works.

Steam is kept up day and night throughout the year.

Night watching is performed by a night watchman. Two firemen, an engine-man, and a night watchman are always on the premises during the night and on Sundays.

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LESSONS FROM FIRE AND PANIC

A Paper

BY

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ETC., ETC.

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OBJECTS:

The main objects of the Committee are:—

To direct attention to the urgent need for increased protection of life and property from fire by the adoption of preventive measures.

To use its influence in every direction towards minimising the possibilities and dangers of fire.

To bring together those scientifically interested in the subject of Fire Prevention.

To arrange periodical meetings for the discussion of practical questions bearing on the same.

To establish a reading-room, library and collections for purposes of research, and for supplying recent and authentic information on the subject of Fire Prevention.

To publish from time to time papers specially prepared for the Committee, together with records, extracts, and translations.

To undertake such independent investigations and tests of materials, methods and appliances as may be considered advisable.

The Committee does not hold itself in any way responsible for the opinions expressed, or methods advocated, by members and others who kindly contribute to these publications.

Comments on the opinions expressed in these papers, or further information on the subjects under consideration, are cordially invited by the Executive, at whose discretion they will be circulated among the members of the Committee.

NOTE.

IT has been the good fortune of the Surveyors' Institute to have had read before it one of the most important papers on Fire Protection that has been prepared during the present decade, and by a noteworthy act of courtesy the Institute has now permitted a reprint of this valuable paper to form one of the British Fire Prevention Committee's publications, in order that its contents may procure a still wider hearing.

The great importance of the paper will be obvious to all who peruse it; for in its pages much from the vast experience accumulated by the chief building official of our metropolis stands recorded in concise and popular terms. As I have so often had occasion to point out the official controlling the execution of local regulations, whether he be architect, surveyor, or engineer, gains a far wider experience as to protective measures than is possible in the case of a professional man in private practice. And when these duties of control are combined with those of an architect actually carrying out from day to day considerable quantities of new work, the experience gained must be of yet broader character, leaving no grounds even for the too frequent accusation that controlling officers regard building work solely with the eye of a legislator, as distinct from that of a practitioner. But, in reality, there is no necessity to speak in these introductory words of the high qualifications of the author; the paper speaks for itself.

As in other publications of this description, it is not my purpose to comment on the contents. In connection with it, however, I am anxious to express from experience gained at home as well as in other countries, that no

matter what the legislative requirements may be in regard to the construction and equipment of buildings, a satisfactory issue depends mainly on the reading given to the regulations, the spirit with which the official enforces them, and the spirit in which he deals with applicants. In no other form of legislation can it be more difficult to define the detailed requirements necessary to meet general purposes, and in no other form of legislation is it more essential that the executive should be able to apply wisely any discretionary powers given them. It is, in fact, curious how the identical wording of regulations framed for different localities, not to speak of countries, is differently interpreted, and has a different effect according to the character and methods of the officers in charge.

As one, too, who has had the fortune to contend with the bureaucratic methods of some foreign countries and the characteristic despotism, caprice, and reckless disregard of the interests of the applicant so often met with there, I cannot help taking the opportunity of this paper to express the opinion that the architects and surveyors of the metropolis, no matter how satisfied with the general administration of our Building Act, really can not appreciate what it means to have the powers of the Superintending Architect under that code vested in such able hands as those of the author of this paper.

EDWIN O. SACHS.

LONDON,
1st August, 1898.

Lessons from Fire and Panic.

WHEN I undertook this subject the fatal fire at the Paris Charity Bazaar had not happened, nor did we anticipate that great disaster among the warehouses at Cripplegate, which has added its own unnecessary lesson. Indeed, neither of these events was necessary, for they conveyed no warning not already known, and they were useless, for by this time they are practically disregarded.

The fact that the destruction of a building by fire is an improbability removes it from the class of considerations with which the architect usually deals. In proportion to the number of buildings fires are exceedingly few, considering the variety of risks I might say surprisingly few; and if it is a hundred thousand to one against a fire in a particular place on a given day, the ordinary man, environed by more threatening perils, will scoff at precaution and take his chance. But after a calamity the general public with all its tongues asks why the precaution was not taken, and looks out for a victim. By the standard then set up, and not by any doctrine of chances, the architect may expect to be judged.

It is a question whether danger from fire is not increasing in spite of Building Acts. Our buildings are getting more lofty, more closely packed together, and more thickly inhabited. In commercial buildings the rooms are larger and more encumbered with goods, among and over which manufacturing processes are carried on. There is more machinery actuated by heat. The timber we use is more easily combustible, fittings

are lighter, and everything is kept warmer and drier. All our arrangements for obtaining light, from the lucifer match to gas and mineral oil and electricity, are novel and productive of new dangers. The proportion of window openings to wall space is much increased, and with the growth of honesty outside, or trustfulness within, shutters have been abandoned. The old-fashioned solid window frame that stood flush with the face of the wall, and being dangerous had to be abandoned, is through modern fashion being brought out again from its reveal and made in thin casing which will catch fire and fall into the street. Lifts going through several stories neutralise the advantage of fire-resisting floors, lighting areas common to different premises do away with the security of the party-wall. Unrestricted skylights bring ridicule on the incombustible roof covering of the Building Acts. In fact the most scrupulously legal building of brick or stone and slate may be no more than a kind of grate in which its internal structure and its contents can be most conveniently burned. So in the Cripplegate fire, the progress was about as rapid, and the destruction over its limited area no less complete, than in the Great Fire of 1666; and if our arrangements for the extinction of fire had not made immense progress, this recent event might have rivalled that great calamity.

Our own lesson from this must be to improve by all means the construction and arrangement of buildings, even though we may be in advance of Building Acts. We cannot widen the streets, nor increase the unoccupied areas, nor reduce the necessary openings for light, nor dictate to the trader modes of conducting his business which would make his business impossible, nor can we do much in advance of public opinion to diminish the numbers of an audience or spread them over a larger area. The most that we can do is to diminish the chances of fire and to delay its progress, to prevent its passage from room to room and from house to house, to

so arrange the construction that a fire may be more easily put out, and as regards the safety of the inmates, to provide the best means of escape.

We should be wiser if we knew more of the causes of fires. The final comment on most of our great fires is "cause unknown." They have destroyed the evidence of their origin. We learn something from the records of those that are most easily extinguished, and we should learn more from the far greater number that are discovered and dealt with on the first alarm without troubling the fire brigade. In one of those summer exhibitions that are spread over buildings of a temporary character, I had information of ten such alarms within six months. In my own house we have had, through no fault of ours, at least three of the narrowest escapes from the kind of gas explosion by which the house of one of my friends was lately wrecked. We may learn something from these and other failures, but our great lesson must be to distrust the safety from fire of any building unless the greatest care is taken in its construction, and on no account to think that any deficiency in that particular will be made up by carefulness in its occupation and management.

The points which I think it most useful to notice are the following :—

(1.) The structure and arrangement of buildings generally.

(2.) Certain legal and other provisions for preventing loss of life in dwelling houses.

(3.) Certain legal and other provisions for preventting loss of life in factories.

(4.) Certain legal and other provisions for preventing loss of life in public buildings generally.

(5.) Certain legal and other provisions for preventing loss of life in theatres and music halls.

With respect to structure, the party-wall as a separation between buildings is, I think, effectual if no illegal openings are made in it. Whether or not it need be

carried up through the roof has been a question, but no satisfactory evidence seems to be forthcoming as to the stoppage of fire by party-walls that are not so carried up. When the London Building Bill of 1893 was before Parliament, the Committee took a great interest in this question, and decided that the old height of fifteen inches above the roof should be raised in the case of a warehouse to three feet.

As to openings in external walls where the streets or back areas are narrow, we want shutters that will delay the passage of fire from without, if only for half an hour, and will obstruct the passage of fire from within. It may be that fire-resisting blinds occupying little space will be found useful. The common lighting areas are formed by what are supposed to be external walls, and the provision of shutters or blinds to the openings in them is even more necessary. Every contrivance of this kind should be easily closed, and should be actually closed every night.

I am quite unable to understand the slow progress made in this country by the fire-resisting floor. In Paris fire-resisting floors were common five-and-thirty years ago. I was then carrying out such work here on a large scale, but the case was exceptional; the weight of the floors was great, the walls had to be thickened, and the cost was excessive. Cheap steel and light substitutes for concrete have changed all that.

In the Cripplegate fire, although many of the warehouses were modern, and some had already been burnt out once or oftener, there was not a single fire-resisting floor. There were wooden floors carried on iron girders, but we are familiar with the behaviour of wrought-iron girders under such conditions. They expand and contract so as to overthrow the walls, or they become soft so as to hang down like tapes. There are now available fire-resisting floors in great variety in which the iron is more or less protected from the fire. In using them care must, however, be taken that no leakage of gas can

accumulate in any hollow spaces. I have seen a large and handsomely decorated house in which fire-resisting floors were used in conjunction with battened walls. Upon applying a light in the usual way to the suspected point of escape the mixture of gas and air accumulated in the hollows exploded, and the ceiling with the wall battening in two stories was stripped away, littering the floors and mixing with the broken window glass. In that case there were also severe personal injuries.

In the great re-housing schemes of the London County Council I have made every floor fire-resisting by the use of steel joists wide-spaced, and filled in solid with coke breeze concrete upon which the floor-boards are nailed, the plastered ceiling being done under the concrete direct. The cost is no more than that of a good wooden floor, while the total thickness is only seven inches, which saves two or three inches in the height of each storey. They are not complained of by the tenants in respect of noise, but in a house where this would be of great consequence a cork covering to the boards under the carpet would be a sufficient remedy.

If it is necessary to adopt wooden construction for floors, the ordinary pugging should at least be used. Joists of double the usual thickness placed two feet apart, and filled in solid with some form of concrete, would offer great resistance to fire. As to the material for pugging, coke breeze and cement concrete, mixed four parts to one, stands fire and water better than anything else. In Switzerland they use coarse plaster stuff, into which long wet shavings have been stirred as hair is stirred into plaster for ceilings; and this, though an imperfect substitute for concrete, will resist a fierce fire for a considerable time, but more experience is required in the use of light solid materials.

I think we have now arrived at a time when architects should at least try to secure an incombustible roof. This is stipulated in the building leases of some very important London estates, and I am told that it raises

no difficulty. If the space in the roof is wanted, pugging or concrete is sometimes put between wooden rafters. If a steep roof is necessary, sheets of asbestos put on the roof boarding in place of felt will afford some protection. In a building professing to any degree of fire resistance, the roof should be protected by a ceiling of concrete put over the topmost storey. Ceiling on perforated or expanded metal will give some protection against a small fire.

As to partitions, lath and plaster should be quite abandoned, and brick-nogging also, for a half-brick wall in cement is as easily constructed. There are many kinds of thin partitions from which to choose. I commonly use coke breeze cement concrete two inches in thickness, which is light, tough, and strong enough for storeys of the ordinary height. Old lath-and-plaster partitions may be filled in with this material or with brickwork by removing the plaster from one side only. If the structure is otherwise fire-resisting, any wooden panelled partitions may be considered as fixtures and disregarded, particularly if in hard wood.

I mention these and similar details, not as being unknown, but as being too often neglected, even where the cost would not be a serious item. If fire-resisting materials were in more regular demand workmen would become familiar with them and they would cost less. Exaggerated estimates of the cost of fire-resisting construction do much harm. Very important steps can certainly be taken in that direction with very little extra cost on ordinary construction.

The great danger of a staircase arises from the cupboard underneath its lower flight, which will probably be stored with combustible materials. If it is constructed of thin deal it will take fire easily. If more solid or made of hard wood it will resist a small fire for some time. If it is to be fire-resisting, concrete is safer than stone. But if everything about a staircase is incombustible it may be rendered useless by accumulated

smoke arising from such a cupboard as I have mentioned, or from an adjoining room.

There are certain precautions necessary in construction whether the materials are fire-resisting or not. I have already suggested the danger of hollow floors and hollow partitions, but all hollow spaces that can contain gas or transmit flame or inflammable vapour, or will even allow a supply of air to pass towards a fire, are highly dangerous. The lining of walls with matchboarding is the most ordinary case of this kind. By means of it fire communicates instantly all over a shop, and up through the floor to the rooms above. The hollows formed in heavy plaster cornices and the hollow spaces behind skirtings transmit flame or inflammable air without any outward warning to adjoining or even distant rooms. One instance or two will illustrate this.

In a fire near Clapham Junction that originated among the Christmas decorations in a draper's window, the smoke and flames passed in this way to the upper floor so quickly, that two girls at work over the back part of the shop lost their lives, although there was an easy means of escape by getting out of the back window on to a flat. In a similar case several persons, probably seized with panic, jumped from first floor windows into the street, instead of stepping out at the back. These are indications of the quick effect of fire in a badly-constructed building.

As to the passage of fire or inflammable vapour by hollow spaces, cases have happened where the origin of a considerable fire was inexplicable until it was traced back to some source at a considerable distance from the scene of the damage. In a "fireproof" building, a workman hung his coat in a cupboard leaving his pipe in the pocket. The coat took fire and fell, setting light to the skirting, behind which a small hole had been left in the brick internal wall. The floor-boards of the adjoining room had been laid on wooden strips that stood above the service of the concrete. The fire passed

along the hollow space, doing three thousand pounds' worth of damage in this "fireproof" building. Unless the elasticity of a floor is an object, the boards should be nailed down on to a surface of coke breeze concrete.

If no more serious measures than those I have described are taken in respect of a purely domestic building, they may give very material security as to its behaviour in case of fire. For many years past companies have been erecting artizans' dwellings in London, one of them having put up blocks containing nearly six thousand tenements. In only one case has a fire in any artizans' block extended from one tenement to another. This is due to generally careful construction, though there has been no rigid adherence to fire-resisting principles.

In these descriptions of the parts of a fire-resisting building, the work of the carpenter is practically excluded, and there are many buildings in which this principle should be carried out. There is, however, much convenience in the use of timber, and if posts and girders are made in large sizes, they are safer than if made in iron. Solid floors made of deal joists set close together withstand fire for a long time, but are ultimately destroyed by great heat.

Many attempts have been made to render fir timber fire-resisting or slow-burning by chemical treatment or by covering it with paint. Some of these applications are useful when applied to textile fabrics and to thin slips of wood, but I have been unable to meet with any process that renders the mass of a joist or beam fire-resisting throughout. This is a matter well worth further inquiry and experiment, for joinery at least might be protected in this way. As to the public experiments sometimes reported, those in which tar or mineral oils are liberally used are untrustworthy, for these are light-giving and smoke-producing liquids, and do not imitate the conditions of an ordinary fire.

Although we may succeed in rendering new buildings

satisfactorily fire-resisting, a much more important question for the present generation is the improvement of the condition of old buildings. This is well worth the attention of those who have the charge of building estates already covered, of ordinary town property, or of those old historic mansions filled with family treasures, one of which as I write has been added to the number of those wrecked by fire. In an ordinary building, purely domestic, if the joists are not strong enough to carry a filling in of concrete they will carry ordinary pugging, and if no more than a breadth of three or four feet all round a floor is well filled in on some fire-resisting system, every hollow behind adjacent cornices, skirtings, and partitions being carefully stopped, a very considerable amount of resistance to fire will be afforded. If, besides, the points of contact between chimney stacks and floors and roofs be examined and timber cut away, the condition of an old house might be made approximatelv as good as that of a new building. In certain cases, where in London a domestic building is changed into a public building, and where a building partly domestic and partly used for trade is increased in area, something of this kind has now to be done.

Even more important than these details of construction is the question of arrangement of buildings with the view of preventing loss of life from fire. Warned by frequent disasters, the legislature has from time to time made provision for protecting persons from sudden fire and panic, and for insuring to the inmates of certain buildings reasonable means of escape.

Examination of this kind must be thorough, for it is difficult to exhaust the possibility of mischief caused by careless workmen in old or in modern times. I have found in an old house the brickwork of a chimney breast cut away to enlarge a cupboard, a thin board being substituted, which had evidently done duty for years in that position.

And with regard to any building, the architect cannot

be too cautious against assuming that reasonable care will be taken in managing it. Most houses are at times, often for a very long time, left in the hands of people without sense of responsibility. That is an additional reason for making every structural provision against the chance of a fire. The fate of Cowdray House, in Sussex, though the story is a hundred years old, contains nothing that might not now be paralleled.

The mansion, which was one of the grandest in the country, was being repaired and decorated in preparation for the owner's wedding, and it was left in the hands of caretakers and workmen. All the more valuable of its contents were temporarily stored in a gallery, and a room close to this place was selected for the carpenter's shop, the fires being closely surrounded with shavings. During the night on which all was finished, fire was observed in the workshop. The neighbours assembled. The moat was full of water, but nobody could find the key of the engine-house. The destruction was practically complete.

The London Building Act, 1894, provides, by Section 61, that every building over 30 feet in height used wholly or in part as a dwelling house or factory, *and having a parapet*, shall have a dormer window or door opening on to the roof, or a trap door with a fixed or hinged step-ladder leading to the roof, or with other proper means of escape. If there happens to be no parapet there is no such provision. I venture to think that it would only be ordinary prudence to make this provision in any house or factory where there is reasonable doubt as to the means of escape by the ordinary route. Section 62 partially meets this view by requiring that any storey in the roof, the floor of which is over 60 feet above the street, shall be constructed of fire-resisting materials; and Section 63 provides that every building over 60 feet high shall have on the storeys, where the floors are over 60 feet above the street, "such means of escape in the case of fire for the persons dwelling or employed therein as can be reasonably required in the circumstances of

each case." No such storeys can be occupied until the London County Council certifies that this has been done. This is new legislation, and it has now become a very important part of the duty of the Council to say what can be reasonably required in such cases.

The height of 60 feet is fixed because that is the greatest height to which a movable fire-escape will reach, and without some special provision the only means of escape from these high storeys would be by descending, if that were possible, to the lower storeys, and increasing the number of persons there in peril. Schemes to be applied to lofty hotels and houses more or less crowded at night have come before me in great variety, many of these very inadequate. It seems clear that the law, which leaves the occupiers of floors up to 60 feet in height to take their chance, intends that those on higher floors shall escape. They may have a gallery or an iron ladder or staircase for access to the roof of an adjoining building, or a series of ladders may be contrived that will conduct them clear of the windows of the burning building down to the ground. But 60 feet is a great height from which to expect women, children and sick persons, scantily dressed, suddenly alarmed in the night, and for the first time in their lives, to descend by an external ladder, in any weather, and probably in the dark. We may realise the condition in which people escape, from the account of a fire that happened at the Scottish mansion of the Duke of Argyll, in which praise was given to the Princess Louise for her presence of mind in running back from the garden to get stockings for the rest of the household who had rushed out barefooted. For people in that condition steep ladders with ordinary rounds are useless. They must be of tolerably good slope, have flat treads and hand-rails and there must be suitable protection where necessary against falling into areas or through skylights. The escape door must have such fastenings only as can be easily opened from within. It must be easily found by night, and the bottom of the escape must be in some

open space quite clear of danger. But whether the escape delivers to the ground or on to some willing neighbour's roof, there is risk that it will be made use of by burglars and by inmates of both premises for improper purposes. If a separate staircase leading down to a separate door of exit is provided in the building, it will very likely be allowed to go out of use, and will be turned into a store place for lumber. On the other hand, if the construction of dwelling rooms above the 60 feet limit is of very great consequence, the owner may reasonably be required to make and keep up such arrangements, however costly, as will be really efficient.

By the 74th Section of the London Building Act, when a building over 1,000 feet in area is used in part for purpose of trade and manufacture and in part as a dwelling house, the two parts must be separated by walls and floors of fire-resisting materials, and all means of approach to the dwelling house portion must be constructed throughout of fire-resisting material. But the walls of staircases and passages may have openings fitted with fire resisting doors to communicate between the two portions, for which purpose hard wood two inches thick is reckoned fire-resisting. For staircases hard wood two inches thick is also permitted, and good concrete when filled in between the joists of floors is fire-resisting.

It will be observed that the term "fire-resisting" is used and not "fireproof." The construction must not add fuel to the fire, but resist it for at least a considerable time, during which the inmates of a building may escape and fire appliances be brought to bear. If the contents of the room or even of the building cannot be saved, so much the worse for the owner or the insurance company; but the fire should rarely extend to the adjoining apartment on either side or to a storey above or below, and the smoke should be kept from staircases and passages. This means giving to adjoining sections of a house as nearly as practicable the same protection against each

other as a good party-wall affords to the inhabitants of an adjoining house.

By the Factory Act, 1891, every new factory in which more than forty persons are employed must be provided on the storeys above the ground floor with such means of escape in case of fire as can reasonably be required under the circumstance of each case. Every old factory must, after notice, be similarly provided, subject to arbitration in case of difference. The Factory Act of 1895 extends these provisions to certain workshops and laundries. I think that the chief fatalities during recent years have been in factories employing less than forty, but there are other provisions for safety and for facilitating escape which may be put in force by the inspectors if the provisions above mentioned are not applicable. As to the application of these structural provisions, it has been said that if the workpeople on the upper floors are provided with means of getting to the ground floor they cease to be subject to the Act, but this view does not seem to be supported by the words of the Act, which require that such persons are to have "means of escape," and the ground floor might be on fire and not available for that purpose. These persons therefore must have means of getting clear of the building either into a street, or by arrangement on to adjoining premises, or into an open yard of ample area. In a confined yard they would be subject to the glow and heat of the fire, and this is fatal. Many of the victims at the Paris Bazaar fire died in the open yard at the rear, which was of some size, but which afforded no shelter from the fire.

The circumstances of each case which the authority or the arbitrator is to take into account appear to be such as arise from the nature and quantity of materials used, the processes employed, the danger from lifts which will communicate fire and smoke, the numbers of workmen and workwomen respectively, and the description of the premises surrounding the factory. It is sometimes argued that "the circumstances of each case" which are

to be taken into consideration include such as arise from the insufficiency or inconvenience of the site, the owner's system of supervision, or other matters which might have been foreseen and provided against in the selection of the site or the construction of the building, and that allowances should be made for such matters of difficulty. But there must at any rate be means of escape, and those which may be sufficient in an ordinary case may reasonably be increased and not omitted if the site, or the buildings, or the system of management are worse than common. If a factory has combustible floors and roof, the requirements may be more stringent than if it is fire-resisting throughout. But unless the plan is satisfactory, the smoke from a very small fire will quickly spread, disabling the workpeople or causing a sudden panic, whether the building is fire-resisting or not.

Some of the causes of danger are the inflammability of the stock, the way it is allowed to accumulate so that insufficient room may be left even for passages, the chance that access to staircases may be cut off by the fire, the insufficient width of the staircases, the bad arrangement of their steps, and their liability to become filled with smoke. As in theatres, there should be alternative means of escape at different extremities of the building. Two rooms may be united by a doorway, each room having its staircase at the other extremity, or two buildings having their own staircases may be united by a bridge on each floor. Generally the staircases should be of concrete, secondary staircases of minor importance being of oak or teak, the treads 10 inches, the risers $7\frac{1}{4}$ inches, the width 3 feet 6 inches to 4 feet 6 inches. There should be a fire-resisting enclosure to each, with self-closing doors opening by pressure in the direction of each, but not so as to obstruct the landings. The staircase should be well ventilated and should adjoin an external wall. If that is impracticable, it should communicate with the street by a very short passage of fire-

resisting construction. The roof of the staircase should be fire-resisting. If iron or other fixed sashes are to be used some should be made to open, so that persons could be rescued by means of them.

I will here allude to other means of escape which are no doubt contemplated. Iron external staircases kept clear of windows through which fire can pass may be constructed. Movable fire-escapes are to some extent recognised, for the factory inspector may require them and the magistrate mav order them. But these are things properly within the duty of the tenant, and do not seem to be what the Acts require of the owner, whose duty it is to put his building into a proper state structurally. Movable escapes are not satisfactory as substitutes for structural requirements. When a new staircase was demanded in an old building the occupier pointed out that there was a movable escape ready to be let down at one of the windows. When asked to show how it worked the window was found to be fastened down, and he proposed to send for a carpenter, who was in the basement. I need not enlarge on the risks of such contrivances when used by persons not in the frequent habit of using them.

Escape downward by means of the staircase being liable to interruption by fire and smoke, other means must be made available. Very little has so far been done to provide escape by the horizontal route towards adjoining buildings or upwards through the roof. To both of these there are, however, serious objections.

The London Building Act prohibits openings through party-walls between houses in different occupations; besides which, few people would run the risk of the improper user of such convenient modes of getting from house to house without the knowledge of the owners. The late Sir Henry Bessemer showed me an ingenious arrangement by which this last objection was sought to be removed. An opening only 16 inches wide by 3 feet 6 inches high was made in the party-wall at a foot above

the floor level. On each side was a very strong iron door and frame, on the inner side of which was a pair of knockers. On an alarm of fire in either house the inmates would open their own door, and ply the knockers on that of the neighbour, who might be expected to come quickly to the rescue. The outside balcony is a much better arrangement, and if it could be generally adopted on each storey, or only for alternative storeys, there would be in most cases reasonable facilities for rescue. But the balcony, though a beautiful architectural feature, is almost unused in this country. It might cause apprehension of improper access from house to house or from room to room. I have, however, lived for many years in a district where every house has a spacious balcony above the ground storey, and I have not heard of this objection. There is an easy means of passing from the window of one house to the nearest window of the adjoining house by fixing a short length of balcony between them crossing the end of the party-wall.

But the best means of escape after the staircase is by way of the roof, a good flight of stairs being provided to the roof door, which should have an automatic fastening. The Cripplegate fire happened to originate in one of the manufacturing warehouses which was first dealt with by the London County Council under the Factory Act of 1891. The two upper storeys were occupied by seventy or eighty workgirls, and the owner willingly put a proper door to lead on to the roof. By this route he and they got away, and without it they must all have perished. But easy as it was, there was considerable difficulty in getting the girls out in the few minutes available, some having fainted or become uncontrollable in their excitement. As the workwomen are usually accommodated, often by hundreds, on top storeys, this is a useful lesson in the construction of means of escape.

I do not suppose that roof doors will be willingly adopted where valuable stocks are kept, but in a district of warehouses where the roofs were properly adapted for

escape there might be a watch kept on the roof against thieves and the outbreak of fire.

The construction and arrangement of public buildings, that is, places of worship, schools, hospitals, workhouses, theatres, halls, exhibition rooms, and other public places of assembly in London, are in certain respects regulated by the London Building Act, 1894. The general construction must be to the approval of the district surveyor, subject to a tribunal of appeal, but the Act requires that the floors of lobbies, corridors, passages and landings, and the flights of stairs shall be of fire-resisting material. Besides this the dimensions of passages, staircases, and exits of new churches, chapels, meeting houses, public halls, lecture rooms, exhibition rooms, or places of assembly are laid down in the Act. Staircases must be carried and enclosed by nine-inch walls, and with the corridors and passages shall be not less than four feet six inches wide, but if not more than two hundred persons are accommodated this is reduced to three feet six inches. If for more than four hundred persons an addition of six inches for every additional hundred is to be made up to a maximum of nine feet and when the width is over six feet there is to be a dividing hand-rail. If two staircases or passages are put instead of one, each must be of two-thirds the above dimensions, but not less than three feet six inches. And if one portion of the public is accommodated over another portion they must have a separate exit. All doors and barriers must open outwards, and no outside locks or bolts are to be fixed.

As regards public buildings in general these are new provisions. They are a somewhat mild adaptation of the much more stringent regulations that have long been applied to theatres and music-halls, and they were very much required.

I was once asked by a member of a Parliamentary Committee who desired to ridicule our theatre regulations why we did not seek to apply them to churches,

and could only suggest the comparatively infrequency of accidents in such places. But the reason was inadequate and Parliament has since recognised this in the above provisions. There are many more accidents in places of worship than is commonly supposed, and the most serious have happened in such places. The crowds are often more dense, and precautions are hardly thought of. One, or perhaps, two doors are thought enough for many hundreds of people. The organ and heating apparatus and vestry are in dangerous proximity, artificial light and decoration are on the increase. A senseless panic ensues on the least alarm.

To go back rather a long way, in 1120 the monastic church of Vezelay, in France, was burnt, with 1,127 men and women. And other similar fatalities are found in old records. Some seventy years ago, at a festival, when the cathedral of a South American city was crowded with the whole female population, the elaborate decorations which thoughtless people always add on festal occasions, took fire, and 2,000 perished, hardly any escaping. A few months ago some decorations in Pisa Cathedral took fire, and in a panic twelve persons were crushed to death and twenty injured. A few weeks ago, fifty-four people were killed and eighty injured at a fire in a church in Russia. A few days ago, the organ and gallery of a chapel in Hull were blazing when the Sunday morning congregation assembled. If this outbreak had been delayed for half an hour we might have had an object lesson in panic. I mention these matters because the architect will feel that he ought not to provide anything less than the moderate securities demanded by the London Building Act; and if one or two additional doors are required, they are at all times a convenience to a crowded congregation. If the precautions above mentioned are required in a new building, I am unable to see why they should not within a reasonable time be demanded in old buildings as well.

But these are matters in which we must expect no help or sympathy from the persons whose lives are thus safeguarded. Twenty years ago the densely crowded church of which I was the people's warden had outer doors opening inwards, and with the support of the vicar I insisted on an internal lobby with doors opening outwards. We did this in spite of unanimous opposition and as no panic has occurred the opponents may say they were in the right.

A few years ago a thoughtful architect provided to the west end of a new church the only efficient arrangement of exit doors that I have seen, but fitted them with a lock. I went to the opening service to see the result. The place was full, even to the standing room, and when the procession from the choir turned to come down the centre passage they could not advance a step. Then, if ever, was the time to throw open the exit doors, but the key was in the vicar's pocket, and he could not be reached except by means that would have been impracticable, and with delay that would have been fatal in case of a panic.

I think it probable that we may not again hear of the fitting up of one of our great churches for some important function with a forest of timber, in stages and seats and galleries, so that either through accident or through malice, a fire may be raised which might result in a calamity even greater than any that has hitherto been known. At the induction of the Dean of Canterbury, when a great crowd was expected, those in charge of the Cathedral were properly careful, and limited the admissions to those who could be accommodated with a reasonable chance of safety to themselves.

Our theatre regulations are made under the Metropolis Management Amendment Act, 1878, and have been much strengthened in recent years, largely through the advice of Sir E. M. Shaw, K.C.B., formerly the chief officer of the Metropolitan Fire Brigade, while the

application of the regulations has become more stringent as their necessity has been more generally appreciated. They are applicable to all places where the public are invited, for music, or dancing, or stage plays, whether on payment, or by ticket or free. I can only mention a few of the things which must now be done in the case of a newly-licensed building, and which are demanded so far as is reasonable and practicable in the case of an old building. As to the latter there is an appeal to the arbitrator.

I am not sure that many theatre architects entirely approve every one of our regulations, but some approve certain of them and others probably approve the rest, for whereas a few years ago not many plans were submitted that would bear examination, there is now a large and increasing number of architects who, so far as their clients will permit them, produce excellent plans and heartily concur in our regulations as a whole. And as to clients, all the more experienced managers are alive to the risks of their undertakings, and very large sums have been willingly spent by them in the improvement of old buildings. Manchester has taken a good lead in theatre architecture. At the present time, when new theatres are being built in all our London suburbs, and even in small provincial towns, no class of buildings is better understood.

In London the site for a new theatre or music-hall must abut for one-half of the boundary upon public thoroughfares, one of which must be not less than forty feet wide. This is exactly one half of the requirement as to site in most continental cities, where, as in Manchester, the theatre must be entirely isolated. But our own moderate demand may be relaxed if the building is of small importance or if the design or surroundings seem to warrant it. We are now actually getting isolated theatres, whereas a few years ago there was not one in London. Not many years ago the owner of a site intended for a theatre would insist on devoting the

best portion of his frontage to shops. If the site consisted chiefly of back land, the owner would consider it particularly eligible for a theatre. Of such a site I once said to the proposer, "Surely nature intended this for a "coal yard," but he was careful to correct me—it had really been a timber yard.

Our regulations provide for the separation of dressing-rooms, and such sources of danger as workshops, stores, painting-rooms, property-rooms, scene-docks, engine-rooms, and gas meter rooms, and regulate the supply of gas, electric light, lime light and water. They require a fire-resisting curtain and a high roof with lantern light over the stage. The mischief of windows opening near adjacent property is sometimes imperfectly guarded against by protecting them with hoppers. Recently a fire was caused in a music-hall by an old accumulation of rubbish carried by the wind into one such hopper and fired by burning soot from a neighbouring chimney. Our greatest difficulties arise out of staircases, corridors, and exits.

People who talk of clearing a theatre in two or three minutes fail to realise the suddenness with which smoke and poisonous vapours spread, nor do they appreciate the effect of a panic, which may prevent an audience getting out at all. If a fire breaks out among the scenery the whole is alight at once ; the vapours make for the upper parts of the auditorium, and the people die where they sit. In the great theatre fires it has been estimated that all the victims died from suffocation within five minutes. These are matters which can be reckoned with, hence the provision of "fire-proof" curtains and high roofs over the stage. But no one can reckon with panic. It needs no fire or other danger. It is a madness to escape from no one knows what. The exits from a public place must allow for panic as well as for fire. Two exits, well-lighted by some independent means, must be provided from every part of the building, and as one may be blocked, each must be capable

of taking the whole of that part of the audience They should deliver into different streets. One of these, which will also be an entrance, may be connected with a vestibule that is common to three entrances, and the doorways of this vestibule must must be one-third wider than the combined widths of these three separate entrances. The least width for an exit is four feet six inches in the clear. Too frequently I find that the exits are actually made of this dimension between the brick-work, so that after deducting the thickness of doors and projecting handles only three feet four inches is left. I consider it unfair to expect one to overlook such mistakes in so important a matter.

All exit doors having fastenings must be fitted with bolts yielding to pressure from within. This necessary regulation gives rise to great difficulty. A manager will suspect that persons get access through these exit doors, and also that his servants get out at improper times. In view of the importance of this point, and the impossibility of securing by any system of inspection the opening every night of a door that has locks and bolts, it may be hoped that there is mechanical ingenuity enough to get over any such objection as I have indicated.

The impossibility of getting the employés about a public place to understand that exit doors and passages are meant to be at all times free and well lighted may be illustrated from experience. The first new theatre that was opened in my time had been rebuilt after a fire, and the proprietor, confident in his arrangements, invited my inspection on the opening night. I found the exits without lights and their doors blocked by the débris thrown out of the building at the last moment. In another case a few years ago the architect had provided admirable exits, but insisted on fitting the doors with locks. In the middle of the first performance I found every door locked and the key at the box office, to be used I was told if required. In a third case, when every-

thing had been found in order, a final visit an hour before the opening disclosed that handsome fixed grills were being put to every exit door, only to be removed in case of need. We have found exit passages turned into lumber rooms, or obstructed by spare tables, by chairs intended for extra and illegal seats in the gangways, by perambulators, and by bicycles. In one case the exit was the home of a savage dog. The architect must never depend on the care with which his building will be managed, and in spite of good intentions the accumulation of spare scenery belonging to pieces that have been taken off or are coming on, and the storing of rubbish, is always a danger. In important continental theatres a separate warehouse is provided as near as possible to, but detached from, the building, and there all scenery and properties not actually in use are kept.

And with respect to this last consideration, experience teaches that in cases of sudden danger no audience, no crowd in a house or factory, and indeed no individual, can be trusted to take the obviously reasonable course to prevent accident or to get to a place of safety. Their escape must be ensured for them by the provision of unobstructed exits that are used habitually, that are as short as posible, and that will take a crowd of people as fast as they can get away. Thus the planning of a building in relation to its exits is often of even more importance than its materials or the question of its site and surroundings, which last is a question often beyond the architect's control. I have advised a theatre architect to begin by laying down on his plan eight staircases and ten or twelve exit doors, and then see whether he had room left for a stage and auditorium. This is more reasonable than planning first these last-named parts and then using up any spare corners for scanty and inconvient stairs and passages.

There is no class of public building so risky as the parochial or mission hall or club room which exists for purposes of instruction or social recreation. The licensees

of such places are very often too inexperienced to feel any sense of responsibility, and the amateurs who usually manage such matters have no sense of danger. Having consented to preside at an amateur charity performance where the stage had been fitted up by the company, I found the footlights to consist of a row of dwarf candles, each being simply stuck down on a penny piece. During the play one of the canvas wings fell upon these footlights.

Unwarned by the Paris disaster, bazaars are got up regardless of the danger from stalls heaped up with flimsy materials and lighted up by Japanese lanterns, without any special means of fire extinction and with indifferent means of escape. In a particularly bad case, while the chairman of the committee was arguing against the possibility of accident, a lantern took fire and fell. No more than this is necessary to produce the worst of those accidents which such premises may be said to invite, and the contents of only one stall would have sufficed.

In view of the wide range of this Paper and the familiarity of this audience with the details of construction, I have for the most part been content to suggest principles upon which we ought to act. And on account of the importance of these questions in relation to the safety of life, I trust we shall agree that there is a moral duty in every one charged with the erection or care of a building to make it as secure against fire and panic as he can. I confess to some feeling approaching pain when an architect, assuming something like the position of a legal advocate, endeavours to argue that provisions made by law for the safety of life and property mean less than they are commonly supposed to mean, or struggles to get some relaxation of the law which, perhaps unfortunately, the public authority has power to grant. Every relaxation beyond what a prudent man would consider safe is in the nature of a wager that nothing shall happen during the whole time that the building will be in

existence which will call for the particular precaution which on the responsible advice of the architect has been injudiciously omitted. It may be that the wager will be won, but the risk is considerable and always there; and this is a consideration which I desire to impress most strongly upon those who are charged with snch responsibilities as I have indicated.

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A Paper

BY

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DELEGATE OF NEW YORK BOARD OF FIRE-UNDERWRITERS TO THE BOARD OF EXAMINERS OF THE NEW YORK BUILDING DEPARTMENT.

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PUBLICATIONS

OF THE

BRITISH FIRE PREVENTION COMMITTEE.

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OBJECTS:

The main objects of the Committee are:—

To direct attention to the urgent need for increased protection of life and property from fire by the adoption of preventive measures.

To use its influence in every direction towards minimising the possibilities and dangers of fire.

To bring together those scientifically interested in the subject of Fire Prevention.

To arrange periodical meetings for the discussion of practical questions bearing on the same.

To establish a reading-room, library and collections for purposes of research, and for supplying recent and authentic information on the subject of Fire Prevention.

To publish from time to time papers specially prepared for the Committee, together with records, extracts, and translations.

To undertake such independent investigations and tests of materials, methods and appliances as may be considered advisable.

The Committee does not hold itself in any way responsible for the opinions expressed, or methods advocated, by members and others who kindly contribute to these publications.

Comments on the opinions expressed in these papers, or further information on the subjects under consideration, are cordially invited by the Executive, at whose discretion they will be circulated among the members of the Committee.

NOTE.

IN the present paper a summary is given of various suggestions as to methods of erecting "fire-proof" buildings. This summary has been prepared in America, and the whole of the questions dealt with have particular reference to the constructional practice of the United States. This fact, however, in no way lessens the value of the paper for the Metropolis and the other great centres of the Empire; for, with slight modifications, it applies equally to the buildings of all countries. But what, perhaps, especially enhances the value of this paper is the intimate association of the author with the insurance world of America and the fact that he has also acted on the Board of Examiners of the New York Building Department. It is the member of a controlling authority, whether he be architect, engineer, surveyor, or public official unattached to any particular technical profession, who takes the broadest view of questions of Fire Protection, and certainly gains a wider experience than is possible in any private practice. And since to this exercise of a controlling authority the writer adds the experience of general manager to an insurance company—for such, or very nearly, is the position of a "president" in the United States—his words cannot fail to carry considerable weight. In this case, however, the paper speaks for itself as a contribution to the subject of exceptional value and of the highest importance to those interested in buildings of the warehouse or factory class. There is no need to speak here of the high qualifications of the author.

As in the case of former papers, it is not my intention to put forward any comments of my own, but I would,

nevertheless, draw attention to the interesting remarks on the effect of rust on ironwork and the advisability of making part of the coverings movable to allow of periodical examination. With a growing tendency to run supply and waste pipes inside the terra-cotta or earthenware covering of iron columns and the like, the rust question becomes even more important than it was when only the deterioration of ironwork from atmospheric conditions was taken into consideration. It is to be hoped that this important matter will secure increased attention, inasmuch as the general introduction into the Metropolis of what are termed "frame buildings" as used in America for warehouses and offices, cannot be far distant. It would, indeed, be bad policy if, while reducing the risk from fire, we were not equally to safeguard a building from the hazard of collapse.

In conclusion, I would take the opportunity of thanking the editor of the Boston "Brickbuilder" for his courtesy in placing at the disposal of the Committee this valuable paper, which was originally prepared for his journal.

EDWIN O. SACHS.

LONDON,
July 1st, 1898.

HOW TO BUILD "FIRE-PROOF."

Introduction.

BY way of preface to the following paper, I wish to say that it has been prepared after careful consultation with well-known experts, and after careful observation and study of numerous fires in this class of structures, and especially in those which caused losses to my own company.

I think it advisable, in an article of this kind, to state, as premises, certain propositions which might be treated as deductions. Some of them are axiomatic or self-evident, needing no demonstration, and ought to appeal to any practical mind as being truths, rather illustrated than demonstrated by the experience of the past few years. In accordance with this line of treatment, I desire to state by way of premise :—

"Slow Burning."

First. It may be claimed that no construction is "fire-proof," and that even iron and masonry could with propriety be designated as "slow burning." The iron or steel used in a modern building has, in its time, been smelted in a furnace which presented no greater capacity for running metal into pigs than some of our modern buildings, whose interior openings from cellar to roof correspond to the chimney of a furnace, and the front door to its tuyere. If a pyrometer could be adjusted during the progress of a fire it would be found to rise quite as high as in any forge.

Openings in Façades.

Second. Glass windows will not prevent the entrance

of flame or heat from a fire in an exposing building. It may seem strange that so obvious a proposition should be thought worth stating, and yet to-day more than 75 per cent. of the "fire-proof" structures of the country have window openings to the extent of from 30 per cent. to 70 per cent. of the superficial area of each enclosing wall without "fire-proof" shutters. Heat from a building across a wide street finds ready entrance through windows, and the several "fire-proof" floors serve only to hold ignitable merchandise in the most favourable form of distribution for ignition and combustion, like a great gridiron, to the full force of a neighbouring fire. This was the case in the burning of the Manhattan Bank Building, on Broadway, in New York, and of the Horne Building, in Pittsburgh. The latter building was full of plate glass windows, 16 by 16 ft. Such buildings are not more capable of protecting their contents than a glass show-case would be. A recent article on the Pittsburgh fire in the *Engineering News* aptly expresses this in the following words: "There seems to be some irony in calling buildings 'fire-proof' which opposed hardly anything to a fire from across the street more sturdy than plate glass!"

Openings in Floors.

Third. Openings through floors for stairways or elevators, gas, water, steam pipes, and electric wires, from floor to floor of "fire-proof" buildings tend to the spread of flame like so many flues and should be fire-stopped at each story. This fault is more generally overlooked than any other. Ducts for piping, wiring, etc., should never be of wood. In the Mills Building, in New York, a fire, not long since, jumped through two or three floors from the one on which it originated, by means of the passageways for piping, electric wiring, etc., comparatively small ducts, but sufficient for the spread of flame. In one instance the fire skipped one floor, where it was cut off, and ignited the second floor above.

"Fire-proofing" Iron Members.

Fourth. In view of the fact that it is necessary to cover iron with non-combustible, non-conducting material

to prevent its exposure to fire and consequent expansion, and in view of the fact that all ironwork, except cast iron, will rust to the point of danger, it is best to use cast iron for all vertical supports, columns, pillars, etc. It is not advisable, of course, to have floor beams of cast iron (except in the form of Hodgkinson beams thoroughly tested). If a floor beam should give way, however, it might not necessarily wreck the building, whereas if a vital column should give way a collapse of the entire structure might result.

Rust.

At a convention held some years ago in New York, at which were present a greater number of experts in iron than probably ever met before or since in one room, there was not one who contended that cast iron would rust beyond the harmless incrustation of the thickness of a knife blade, whereas there was not one who did not believe wrought iron would rust to the point of danger; and there was not one who claimed to know whether steel would or not, each admitting that steel had not been sufficiently tested as to rust to warrant a reliable opinion. If it could be relied upon as rust-proof, it would be superior to all other material for "fire-proof" buildings because of its great strength in proportion to weight. The use of steel in construction is growing, because it is cheaper than wrought iron, as lighter weights are used for the same strength, but while supposed to be superior to wrought iron, some of the prevailing impressions with regard to it are erroneous. Defects not possible of detection by tests are liable to exist in its structure. Among the first steel beams brought to the city of New York there were instances in which they were actually broken in two by falling from the level of trucks to the pavement, probably due to their having been rolled when too cold, as steel when rolled below a certain temperature becomes brittle. Better beams are now made.

In my opinion, cast-iron columns are superior to steel and more reliable. It is not generally known that American cast iron is vastly superior to English cast

iron, and will stand a greater strain without breaking. Cast iron, moreover, will not expand under heat to the same extent as wrought iron and steel, which is another fact in its favour.

Columns should be stripped.

No bearing column should be placed in such a position that it cannot be uncovered and exposed for examination without danger to the structure. One of the ablest architects in New York makes it a rule to so "fire-proof" his columns that they can be examined at any time by removing the "fire-proofing" to determine whether rust has invaded their capacity to carry their loads. In my judgment, periodical examinations should be made, from time to time, in this way, of all wrought-iron or steel columns, as it may happen that a leaky steam or water pipe has worked serious harm. Such a discovery was accidentally made recently in an important New York building.

Cement as a Preventive to Rust.

Numerous newspaper paragraphs appear, from time to time, which claim that metal stripped of its covering of cement has been found exempt from rust, with the paint intact, etc., and the fact is cited as evidence that cement is a preservative of iron and that the danger of rust is over-estimated. It is probable that cement will protect paint for a long time, and, of course, paint, if properly put on, will protect iron while the oil in it lasts. Painting, by the way, should be done with the best quality of linseed oil and without the use of turpentine, benzine, or dryers. It should be thoroughly applied in three coats, with about a gallon to 400 sq. ft., and the iron should be first thoroughly cleaned of rust and dirt, by picking or other process. Paint is rarely properly applied, however, and even when of the best quality, is a preservative of the metal, as already stated, only so long as the oil in it lasts.

Those who claim to have evidence of the exemption of iron from rust rely, I think it will be found, upon iron which has been under exceptionally favourable conditions, free from dampness, the action of gases, etc., overlooking the fact that a leaking water pipe or steam

pipe, or the escape of gases from boiler furnaces, will attack iron and gradually but surely consume it. A notable instance of this is the case of the plate girder of the Washington Bridge over the Boston and Albany Railroad in Boston, where a quarter-inch plate girder was recently found to be entirely consumed in places from the operation of gases from the locomotives passing below.

It is quite common to have advocates of wrought iron cite railroad bridges and the elevated railroad structures of New York as proof of their claims, but if they will take the trouble to examine these structures, they will discover that in spite of the fact that they are exposed to view, that they can be painted frequently, the evidences of rust are unmistakeable, especially about the rivets; and one can well imagine what would be the result in the case of riveted iron members in the skeleton structure of a building where such ironwork is entirely concealed from view, periodical inspections being impossible.

Rust is especially liable to be found in the cellars and basements of buildings. The wrought-iron friction brakes of freight elevators in the cellars of stores, for example, are frequently found so consumed with rust as to be easily rubbed to pieces in the hand.

Steel rivets are dangerous and they should never be used, unless of a very superior quality, so soft that hammering will not crystallize the material, and yet with sufficient tensile strength to insure perfect holding qualities. This is difficult to secure. Their use in columns for buildings is objectionable, as they rust badly under certain conditions; columns, therefore, should be without rivets, and the beam-bearing bracket shelf on cast iron columns should be cast in one piece with the column.

Expansion of Iron.

It is generally supposed, and frequently stated, that there is a great difference between the expansion of iron and masonry by heat. This is not the case. For example, the length of a bar which at 32 degs. is repre-

sented by 1, at 212 degs. would be represented as follows:—

Cast Iron	1·0011
Wrought Iron	1·0012
Cement	1·0014
Granite	1·0007
Marble	1·0011
Sandstone..	1·0017
Brick	1·0005½
Fire-brick..	1·0005

In the "fire-proof" building of the Western Union Telegraph Company, in New York, some years ago, a heavy brick pier, 7 or 8 ft. in diameter, adjoined the wall of the boiler furnaces. The difference in expansion in the brickwork next to this furnace wall as compared with that of the remaining brickwork of the pier was so great as to produce a crushing of the material from top to bottom of the pier for a depth of several inches, and it was found necessary to change the furnace wall and leave an air space between it and the pier.

Relative expansion of iron and masonry.

While the difference in expansion between masonry and iron incorporated with it is less per running foot than is generally supposed, and while the difference in expansion between a cubic foot of iron and that of a cubic foot of masonry would hardly be noticeable, especially if the iron were covered on all four sides, yet in stretches of 50 ft. or more, as in the case of iron I-beams and girders, the cumulative effect of expansion in uncovered iron might be a serious matter—quite sufficient with the rises of temperature due to a burning building to push out the bearing walls and wreck the building. Especially is this true of temperatures higher than 500 degs. It is unnecessary to suggest that metal differs from masonry in the important respect that heat does not travel throughout the entire length of the latter, while it does in the case of metal.

In other words, while the difference between the expansion of a lineal foot of iron as compared with a lineal foot of masonry, marble, brick, etc., is very slight,

the difference in conductivity is very great. The conducting power of silver, for example, being represented by 1, copper would be ·845, cast iron ·359, gold ·981, marble ·024, and brick ·01—an important fact to be considered in the construction of buildings. Brickwork raised to a white heat would not raise the temperature of other masonry in the same wall a few feet away, but one end of an iron I-beam could not be raised to a white heat without raising the temperature of the beam for its entire length.

It is a well-known fact that iron responds so readily to temperature that, in surveying land, a surveyor's 100 ft. iron chain, will, in measuring the distance of a mile, result in a variation of 5 ft. between winter temperature and summer temperature, resulting in an error of one acre in every 533.

Preventions against expansion.

Where iron beams and girders are inserted in walls without sufficient space left for their expansion under heat they are almost certain to overthrow the bearing walls by their expansion thrust. A large warehouse in Vienna in which such provision had been contemplated by the architect was totally destroyed, with its contents, by reason of the fact that an officious subordinate, discovering the space in the wall purposely left at the end of each beam, deliberately poured liquid cement therein, which, having set, effectually thwarted the well-meant intention of the architect, and resulted in the destruction of the building.

Expansion thrust.

The expansion thrust of iron beams may be computed upon the following factor of expansion: Rolled iron of a length of 1,562 ft. will expand one-eighth of an inch for every degree of temperature. The heat of a burning building as already stated is enormous—sufficient to fuse most known materials; it may safely be estimated to be at least 1,000 degs.; therefore a length of rolled iron of 1,562 ft. at 1,000 degs. of temperature would expand about 125 ins., and a 50 ft. length of iron girder would expand between 4 and 5 ins., showing that there should be a play at each end of at least 2 ins. if the iron

is not fire-proofed. Inasmuch as in iron construction the iron beams and girders are usually anchored to the walls to steady them, space should be left and the tie to the anchor should be by a movable hinge joint, which would be of the same strength with an inflexible anchor for all tying purposes, but would yield under the thrust pressure like an elbow and allow play of the beam, or stiff anchors should have elongated holes to allow expansion when beams are of great length. Girders are seldom over 25 ft. long, but if bolted together, as is frequently the case, they may be 120 ft. or more long, and a line of columns from cellar to roof of a building may easily have one continuous iron structure of two hundred or more feet. It should be remembered, however, that this danger from the expansion of iron may be almost wholly counteracted by protecting it from exposure to fire through the use of non-conducting material. It is more important to protect girders than beams.

Unprotected ironwork.

The mistaken pride with which the owners of some buildings point to exposed iron beams in ceilings as evidence that the floors are "fire-proof," actually justifying the supposition that they are left exposed for such display, would be ludicrous if it were not serious. In buildings occupied for offices or dwellings, where there is not sufficient combustible material to endanger the beams, it is not so objectionable; but in warehouses and stores, filled with merchandise, such construction is dangerous; and if one of the upper floors should give way it would come hammering down to carry all below and thoroughly wreck the structure.

In this connection it is well to say that combustible merchandise should never be stored 100 ft. above the street grade even in a "fire-proof" building, since the average fire department cannot reach it at that height.

Roof.

Fifth. The roof, that portion of a building which ought to be most carefully watched during construction, is often the most neglected, woodwork entering into the composition, as in the case of the Horne Building, at

Pittsburgh, where the cornice was supported on wooden outriggers.

Sixth. Partitions. These should not be erected upon wooden sills, as is sometimes the case—only, however, with ignorant and inexperienced architects, who suppose that it is necessary to use wood in order to nail base-boards and other trim at the bottom of the partition. Porous terra-cotta will hold nails and should be used in preference to wood, which, as soon as it burns out, will let down the entire partition. Partitions.

Seventh. All buildings over 125 ft. high should be provided with 4 in., or, better still, 6 in. vertical pipes, with Siamese connections at the street, for the use of the fire department, extending to the roof, with hydrants at each story and on the roof. This would save the time of carrying hose to upper floors—a difficult task in the case of high buildings. Ample tanks of water should be provided on the roof, supported by protected iron beams resting on iron templates on the brick walls, to supply the building's inside pipe system for fire extinction, and secure pressure by gravity or by some other method constantly operative, especially on holidays and at night. Stone templates should not be used, and care should be taken to secure strong supports, so that, in the event of fire below, the tanks will not come crashing through the building to destroy it and endanger the lives of firemen. Two such disasters in "fire-proof" buildings within a year show how true is this proposition. Tanks in the basement, under air pressure, are also a great advantage, and recent invention has perfected them to the point of reliability. Water Standpipes.

Fire Marshal Swenie, of Chicago, urges that standpipes should not be less than 6 ins. internal diameter, and that a check valve should be provided, so that when steamers are attached, their force will be added to that of the local pumps. Each floor should have hose connections with the standpipes, and sufficient hose to reach to the most remote point of the floor above, and this hose should be frequently inspected to see that it is in order. He recommends that a code of signals,

by which communication can be established between the firemen and the engineer of the building is essential.

Night Watchman.

Eighth. All high buildings should have constantly present, night and day, some competent person understanding the elevator machinery, fire appliances, etc., so as to aid the firemen in reaching the upper levels; and there should be sufficient steam in the boilers, at all times, to run one elevator.

I quote from the valuable treatise on handling fires in these buildings presented by Fire Marshal Swenie to the International Association of Fire Engineers held in August, 1897. He says:—

> In case the elevators fail, it is necessary to use the stairway, and after the truck men should follow the pipe men bearing the necessary hose, and this must be carried on the shoulders of the men. A 50 ft. section of ordinary 2½ in. cotton hose, with couplings, weighs from 56 to 60 lbs., and 250 ft. of 1¼ in. rope, about 65 lbs, either of which is a good load for a man who must climb a steep stairway to the height of 250 ft. With an average rise of 7 ins. per step, that means taking some 430 vertical steps before reaching the scene of action, and consuming from seven to ten minutes of time. If it is found necessary to use hose instead of the standpipes for taking the water from the street to the floor, the hose should be taken up in the elevator, if it is running, and then lowered until connection is made with the hose below.

Stone Staircase Treads.

Ninth. Marble, slate, and other stones are certain to disintegrate or crumble when subjected to the joint action of heat and water. For this reason 90 per cent. of the staircases in modern "fire-proof" buildings would be found utterly unreliable in the event of fire, either for the escape of the inmates or for the use of firemen—a serious consideration. Stone treads are usually let into iron rabbet frames, and as these stone treads would give way in case of fire, it would be impossible for a person to find a footing on the stairways; 2 in. oak treads might actually last longer; but a safer staircase would be one the framework of which is of iron, the tread having an iron web or gridiron pattern, the interstices or openings of which should be small enough to prevent the passage of a foot, underlying the stone or slate, so that if the stone tread should disintegrate, the staircase would still remain passable.

It is possible to have the supporting tread of open-work cast iron in an ornamental pattern, which, in relief against the white marble tread resting on it, would present a tasteful appearance from the underside or soffit of the staircase, with this great advantage, that, in the event the action of fire and water should pulverise the marble or slate tread, it would still afford a safe support for the foot. In the case of the burning of the two "fire-proof" buildings, Temple Court and the Manhattan Savings Bank, in New York, the slate treads yielded early in the fire, leaving staircases with openings the full size of the tread, which, within a few minutes after the fire started, were impassable for either firemen or inmates. It is astounding that this vital fault should be so generally overlooked in "fire-proof" buildings.

I may here state that the Manhattan Savings Bank building did not deserve to be called "fire-proof," for the reason that it had hollow spaces under the wooden floor boards, and that the iron beams and girders were not protected. Some of them were large riveted box-girders, which yielded quickly to the heat of burning goods and pushed out the side walls.

It is generally supposed that it is not necessary to be careful as to stone treads in buildings occupied solely for offices separated in "fire-proof" hallways in which, it is claimed, there is nothing to burn; but in the case of one large "fire-proof" building of this kind in New York, I found the space under the staircase in the basement story was used to store the waste paper and rubbish of the building—material particularly likely to cause a fire by concealed matches, oily waste, cigar or cigarette stumps, etc., and to make a lively and quick fire, quite sufficient to destroy stone staircase treads. Even where there is no combustible material in the hallway, if the staircase is near windows, stone treads may be destroyed by exposure to burning buildings and by the combustion of window frames, dadoes, and other wooden trim.

Tenth. No building should exceed in height the width of the street on which it is located, from the view

Height of buildings.

point of light and health; nor, in any case, in excess of 95 ft. for mercantile occupancy, nor a height in excess of 200 ft. for office occupancy.

Destructibility of Contents.

Eleventh. It should be remembered that merchandise, furniture, etc., are combustible, no matter whether located in "fire-proof" buildings or in ordinary buildings. This obvious fact seems generally to be ignored. In fact, combustible material will sometimes be more effectually and thoroughly destroyed in a "fire-proof" building than in an ordinary building, since the early collapse of the latter may smother the fire and effect salvage, whereas "fire-proof" floors support the contents of the former, and distribute them so that they are more certain to be destroyed. There was not a dollar of salvage in the great stock of merchandise in the Horne Building, at Pittsburgh. The entire household furniture of a tenant in one of the best "fire-proof" apartment houses in New York, was totally cremated, and a fire in the Great Northern "fire-proof" Hotel, at Chicago, seriously burned the automatic organ to the extent of over $4,000. There is no more reason why the combustible contents of a "fire-proof" building should not be consumed than why the fuel in a stove should not be burned.

Enclosing

Twelfth. Enclosing walls. These should be of brick, the brickwork of the lower stories especially, if not of all, being laid in cement mortar. In fact, the specifications for a building in the compact part of the mercantile section of a city, ought to be drawn in contemplation of the possible cremation of its contents, and the generation of heat considerably greater than 2,000 degs. Fahr. The heat of a wood fire is from 800 to 1,140 degs.; charcoal, about 2,200 degs.; coal, about 2,400 degs. Cast iron will melt at between 1,900 and 2,800 degs.; wrought iron, 3,000 to 3,500 degs.; steel, 2,400 to 2,600 degs.; and if an architect should be required to draw specifications for a building adjoining others, with the knowledge beforehand that its entire contents, from cellar to roof, were to be totally consumed, and he were

under a bond to pay damages to surrounding property, he would not be more severe in his exactions than should a building law protecting neighbourhood rights in the enjoyment of property; for a mercantile or manufacturing building sometimes generates a greater heat in combustion than a smelting furnace.

Foundation.

It is hardly necessary to deal with the foundations of buildings. The question is an engineering problem which hardly requires suggestions from a fire standpoint, and I shall not deal with it here, other than to touch again upon the important point of not having wrought-iron or steel columns in the cellar or basement, where moisture and gas conditions would increase the danger of rust.

Enclosing Walls.

These, as already stated, should be of brick, the lower stories laid in cement mortar, not less than 16 ins. thick at the top of the building and increasing 4 ins. in thickness for every 25 ft. in height to the bottom. This would require a 44 in. wall at the grade for a 200 ft. building. The thicknesses here recommended are for buildings not exceeding 100 ft. in depth. If they exceed this depth without curtain or cross walls, or proper piers or buttresses, the walls should be increased in thickness 4 ins. for every additional 100 ft. in length.

Brick is the best known resistant of fire. Stone yields readily to the combined effect of heat and water, and even terra-cotta or burned clay tile cannot be regarded as a perfect substitute for hard-burned brick.

Under no circumstances should the iron framework of a skeleton building be incorporated in thin enclosing walls. No wall that has not a cross section sufficient to support itself without the ironwork should be allowed, aside from the importance of having it thick enough to prevent the passage of hot air from an adjoining building.

Curtain walls for enclosing walls supported by the longitudinal members of skeleton construction are objectionable; they are liable to be buckled out by the expansion of the framework. The great trouble with

modern "fire-proof" structures, even under the New York building law, is that while the separating "fire-proof" floors tend to prevent the passage of flame from one story to another, the enclosing walls are often insufficient to prevent heat from igniting the contents of an adjoining building, so that what is gained by preventing the spread of fire vertically is lost laterally.

Thickness of Walls.

It should be borne in mind that the thickness of walls herein recommended is not for carrying capacity as bearing walls. Thinner walls would answer for that purpose. It is intended to confine the heat generated by a fire, and should be required in the compact portions of cities, where every man should be compelled to build with reference to the safety of his neighbour.

Architects and builders generally seem to have in mind only the carrying capacity of walls, and to lose sight of this important fact.

As the contents of a mercantile building and its floors burn, they sink to the bottom, where enormously high temperatures are reached, and it is for this reason recommended that walls should increase in thickness as they approach the bottom, on the same principle that the walls of smelting furnaces are thicker at the bottom than at the top.

It is the generally accepted opinion that a 12 in. brick wall will prevent the passage of fire, but a much thicker wall will fail to confine the heat of a burning building, on the first floor particularly, sufficiently to prevent the ignition of combustible merchandise or other material in an adjoining building. In a fire which occurred in Boston, several years ago, combustible material was ignited through a 3 ft. wall, which became so hot as to thus conduct the heat into the adjoining building. In an isolated location an owner might be permitted to construct his walls with reference only to their carrying capacity, but where he builds in the compact part of a city, storing combustible materials from cellar to roof, he should be required to build so that a fire in his premises will not necessarily destroy his neighbour's property.

He may well observe a regulation which, in view of the fact that the buildings of his neighbours out-number his own a thousand to one, will ensure that he shall be in that proportion the gainer by rules which secure the safety of all though imposed on himself.

Skeleton Construction.

I do not believe "skeleton construction" so called should be permitted for stores, warehouses, or manufactories in cities, as the walls are not thick enough to confine the heat of burning merchandise.

In some of our Western cities, Detroit, Chicago, etc., the practice is growing of using hollow tiling, bonded like ordinary brickwork, 12 ins. thick, for enclosing walls, instead of brick, the exposed steel frame being protected by terra-cotta slabs about an inch thick. Such a building would burn more quickly than an ordinary wooden-joisted building properly constructed. The Leonard Building, in Detroit, destroyed by fire Oct. 7, 1897, was an example of the great danger of this style of construction. It was ten stories high, and as fast as the columns or wall girders were warped by the heat the tiling dropped out like loose bricks, leaving the entire structure after the fire a ragged cage-work of iron with very little of the tiling on the enclosing walls and none of the floors intact. The contents were, of course, totally destroyed.

Piers, Bond Stones, etc.

Bond stones should not be allowed in piers, especially in the cellar or basement, or in piers vital to the building or carrying great weights. Stone yields readily and quickly to the combined effects of water and heat and, disintegrating at its edges, gradually releases the bricks above it, so as, in time, to destroy the integrity of the pier. Bond stones are employed by the mason to steady his work. A green brick pier while being laid is frequently unsteady, and a bond stone enables him to progress with his work by steadying all below it so as to receive new courses of brick. In all cases the bond should be a cast-iron plate. If the plate should be cast with holes through it about 1½ ins. in diameter, so that the mortar and cement can thoroughly incorporate the

plate with the masonry above and below, it would be an improvement. Wrought iron is liable to rust and should not be used. Where bond stones are used in the outer walls of buildings they are less objectionable, but for inside piers they are so dangerous that they ought to be prohibited by law. Strangely enough, only stone for bonds used to be required by the New York building law, and such was the opposition of the stone men to the prohibition of bond stones altogether, when later it was proposed, that a compromise was reached allowing the use of cast-iron bonds as an alternative of stone bonds—an option seldom availed of by architects, builders, or owners, however, and construed generally by the public to mean that either is good enough.

Stone Pillars.

It not infrequently happens that a building of otherwise admirable construction has its weakest point in the cellar, where a stone pillar forms the basis of support of the entire line of columns through the building. In case of fire and the application of water these stone pillars, no matter how substantial, whether single monoliths or stone blocks, will rapidly disintegrate and bring down the entire structure; and inspectors should carefully examine, especially in the cellars, for such construction. After the great Boston fire, granite piers were shovelled up and carted away like so much sand. It is quite a common practice, but a most dangerous one, to employ single stone columns, often of polished granite, to support the centre of a long stone lintel carrying the wall over the ornamental entrance of a building. Such a column would surely yield to the effect of fire and water and perhaps let down the entire front. In almost any city (and New York is no exception), such faulty architecture may be observed. The writer passes every day a costly structure on Fifth Avenue whose corner is supported by a single granite monolith column of this kind. If stone columns are desired for architectural effect they should, wherever they carry heavy loads, contain a centre column of cast iron of sufficient carrying capacity to support the superimposed weight.

Cast-iron Vertical Supports.

The vertical supports, columns, pillars, etc., as already stated, should be of cast iron, cylindrical in form, of liberal thickness, especially in the lower stories, thoroughly tested as to sand holes, thin places, etc. Cast iron columns should be round, and not square. In the former shape there is less likelihood of defects in casting, sand holes, etc., resulting in uniform sound thickness of the shell. The columns should be planed to smooth bearings, so that the entire system of columns, from the foundation to the roof, may be securely bolted together and form a continuous line with joints for expansion and without any inequalities of bearings. Under no circumstances should wedges or "shims"* be allowed. This most important matter is often neglected. The flanges and corbel brackets for supporting beams should be cast in one piece with the column and not depend upon rivets or bolts. Rivets, aside from the danger of shearing strains, are almost certain to rust to the point of danger. The beams should be riveted or bolted to lugs on the columns, however, as a tie between the side walls, holding the entire structure firmly and consistently together as one rigid whole and yet with play for expansion.

Col. George B. Post, of New York, has devised a form of cast-iron cage construction consisting of pillars and floor beams the members of which lock into each other, without the use of bolts or rivets, forming a very rigid construction, and saving the cost of mechanics for bolt and rivet work. While I have not had an opportunity to examine it, I have great faith in his judgment; my impression, from his description of it, is that it would be a very rigid construction and admirably adapted to warehouses six and seven stories high. Above this height merchandise should not be stored in any kind of a building.

The factors of safety, in computing strains, should not be less than those prescribed by the standard modern authorities. Better be sure than sorry.

* "Shims" are pieces of slate or iron inserted to secure a true vertical, where the two surfaces have not been properly levelled or planed.

"Fire-proofing" Iron Members.

All ironwork, columns and pillars, beams and girders, should be "fire-proofed," *i.e.*, covered with at least 4 ins. of incombustible material, terra-cotta or brick. At the floor, and for a height of 4 ft. in mercantile buildings, a metal guard should be employed to prevent the column from being stripped by collisions with rolling trucks for moving merchandise. It ought to be unnecessary to suggest that wooden lagging should, under no circumstances, be used to cover iron, were it not for the fact that in one of the largest and most costly dry-goods stores in New York, the "fire-proof" covering of the iron columns, which had been seriously damaged by trucks, was being systematically removed in order to substitute wooden lagging, when the fault was, fortunately, detected by an inspector of the underwriters. 4 ins. of good brick-work is a good covering, but porous terra-cotta, or even wire lath and plaster, may prove effective. Where wire lath and plaster is used, the column should first be wrapped with quarter-inch asbestos, bound with wire. This would prove reliable and inexpensive.

It is a fact, showing how common is the neglect to cover iron with non-conducting material, that in the State Capitol, Albany, N.Y., in the library, is a large plate girder entirely exposed. This girder supports the ceiling beams, and there is enough combustible material in the oak bookcases, furniture, and flooring to wreck this portion of the building by expansion in case of their combustion. The New York Building Law was enacted in this building. The ceilings of the Assembly and Senate chambers are of heavy, hard wood, attached to the soffits of the iron beams, and they would, if ignited, probably warp and expand the beams to a dangerous point.

A notable instance, showing the necessity of protecting ironwork with incombustible material, and the danger of expansion in long lines of iron girders or beams, was that of the destruction of a "fire-proof" spinning mill at Burnley, England, recently. This mill was 210 feet long by 120 feet wide, six cast-iron girders of the Hodgkinson type, each 20 feet long, spanned the

120 feet width, being bolted to cast-iron columns, and carrying, in turn, cross girders of wrought iron. The expansion of these 120 feet girders (they were unprotected) resulted in the disruption of the floor and the destruction of the mill. The cast-iron columns, being unprotected, collapsed under fire and water. The floors were 10ft. 6in. bays. As already stated, beams should not be spaced over 5 ft. on centres. Wider spacing results in weak arches, liable to be buckled out by heat or punched through by the falling of safes or of other heavy articles from upper floors.

The probability is that if the 20 ft. girders in this building had been arranged with provision for expansion, and all the ironwork had been thoroughly protected with "fire-proof" material, little damage would have been done. The effect, if the floors had been loaded with combustible merchandise, would have been more rapid. There was little wood to burn in the contents of the spinning mill, and yet the destruction was thorough. Such buildings with uncovered ironwork are more dangerous than those of heavy wood construction, in which the timbers are 12 inches or more in diameter, and not more than five stories in height. A properly constructed building with protected iron, however, is of course superior to any other form of building. Experienced firemen are afraid to enter buildings supported by iron columns unless they are thoroughly "fire-proofed," as they are liable to snap without warning under the influence of fire and water, whereas wooden posts burn slowly and give notice of collapse. They will stand a severe fire without being charred for more than two inches of their surface.

Beams and Girders.

In mercantile buildings and factories, beams, as already stated, ought not to be spaced more than 5 ft. apart, no matter what kind of arch is employed; and while many experts claim that a heavy iron I-beam, thoroughly encased in "fire-proof" material on three sides, and having only its soffit or under side exposed, would not be expanded enough by the heat of a fire to cause its

collapse, it is best to take no chances, but to protect the under side with "fire-proof" material, which can be cheaply applied with wire lath and plaster, or by having the skew-backs of the terra-cotta floor fillings extend below the soffit or bottom flange of the beam, and made with lips for protecting the iron.

Tie-rods.

It is a mistake, in my judgment, to dispense with tie-rods, even with the kinds of arches which employ wire cables or other metal ties. The claim is made that these act as tie-rods, but it should be remembered that they cannot be relied on during construction, when derricks for hoisting iron beams and other materials are resting on the girders. Dangerous lateral movements and twistings of the structure may be the result of want of rigidity, which can only be obtained by using tie-rods.

Material for Arches between Beams

It is my opinion—but there are many who entertain a different one—that the old-fashioned brick arch is the most reliable for resisting fire; that next to this in safety stands the porous terra-cotta segmental arch, with end construction, *i.e.*, the blocks or separate pieces placed end to end between the beams, instead of side by side, in what is known as "side construction." This is said to be stronger than side construction. It is claimed by many experts that porous terra-cotta is a better non-conductor than brick on account of its interior air spaces. The arch should not be less than 4 ins. thick, having a rise of at least 1¼ ins. to each foot of span between the beams, and there should be a covering of good Portland cement and gravel concrete over this to ensure a waterproof floor. Cinder filling will burn—crushed slag from blast furnaces is better, but the Portland cement concrete should not be omitted for waterproofing purposes.

There are many patent floor arches for filling between I-beams which have great merit when properly put in, but I doubt if any of them are equal to the two I have named, and it should always be borne in mind that when employed they should be inserted with the same care with which they are prepared for tests. This is

almost equally true, however; as regards brick and burnt-clay arches, also. There is less likelihood of poor installation work, however, with brick arches or segmental arches of porous terra-cotta or burnt clay. Arches should be laid in Portland cement, not lime mortar. Under no circumstances should they be laid in freezing weather, and where concrete is used the broken stone or gravel should be carefully washed, and the cement should be of the best quality.

Waterproof Floors.

It is of great importance that the floors of all buildings should be waterproof, in order that the volume of water thrown by the fire department to extinguish a fire may be carried off without injury to merchandise on the floors below. Neglect of these precautions is criminal in view of their simplicity and inexpensiveness.

After the arches have been set between the I-beams they should be covered, for at least a thickness of 1 in., with the best Portland cement concrete, carefully laid, so that all water will run to the sides of the building and be carried off by water vents or scuppers, which may be arranged with pipes through the walls, having a check-valve which would prevent the influx of cold air and yet admit of the out-flow of water.

Ducts.

All ducts for carrying steam, gas, and other pipes and electric conduits should be protected with a metal sleeve going above the surface of the floor, and the space between and around the pipes should be filled in closely with mineral wool, asbestos, or some other expansive and "fire-proof" material to cut off draughts and flame.

Floor Surfaces.

Floor boards should be dispensed with, if possible, and asphalte or concrete employed instead. It is hardly practicable in office buildings, however, to dispense with wooden floors. Wherever used they should be so laid, especially in mercantile or manufacturing buildings, that there is no air space to supply a passage for flame and to form a harbourage for rats and mice, to which these vermin can carry matches, oily waste, or other combustible material, liable to be ignited by steam pipes or by spontaneous combustion.

"Fire-proofing" Wood.

Various processes, "electric," so called and otherwise, have been patented for "fire-proofing" wood. They undoubtedly increase the fire-resisting properties of wood for interior trim, window casings, etc. Whether or not they impair the durability of wood is a matter as to which I am not yet informed, and I doubt if sufficient time has elapsed for a proper test. The United States Navy has made trials of "fire-proof" woodwork—with what success I am not informed.

Ventilating and Light Shafts, Dumb-waiter Shafts, etc.

The enclosures of all ventilating shafts, for water-closets, etc., light shafts, and dumb-waiter shafts should be constructed in the same substantial manner as freight elevator shafts. It is a mistake to use thin plaster board or plaster with dovetailed, or other metal, lath, etc. No enclosure should be relied upon less than 4 ins. in thickness, well braced with angle iron, but brick walls are best, especially in buildings over 60 ft. high. The lights should be of wire glass, set in metal framework, and ventilators should have metal louvers arranged to secure ventilation but not to increase a draft. Slats should be riveted, not soldered, to metal framework, and the metal framework should flange well over the "fire-proof" material of shaft on both sides. It is possible to finish tin-covered "fire-proof" doors with wooden trim so as to be ornamental, with bead panel-work, etc.

Well-holes.

These should be avoided if the building is to be regarded as "fire-proof." The Horne Building had one 48 by 22 ft. It is almost impossible to control a fire starting in the lower floors where a well-hole opens through those above. Luxfer Prisms are now used to secure light from side windows, it is claimed, with great success.

A recent fire test of the Luxfer Prism, in Chicago (March, 1898), is stated to have been satisfactory to Fire Marshal Swenie, as showing that these prisms afford material protection from the heat of a neighbouring fire in an exposing building, and that, to some extent, they are substitutes for iron shutters.

Staircases, Elevators, etc.

These should be in hallways cut off from the rooms at each story by fire walls and doors, to prevent drafts. It

is not so important, and is not so practicable, in the case of office and hotel buildings as in the case of mercantile and manufacturing buildings; but it is advisable, even in office buildings, to have the staircases, elevators, etc., in a separate hallway, the division walls of which should extend through and above the roof, and any skylights should be covered with glass not less than ¼ in. thick.

Skylights.

It is contended by some that skylights should be of thin glass, so that they will break easily and permit the escape of smoke and gas. Smoke is inflammable, and when it accumulates in a building, often spreads the fire from story to story, or blows out the walls by the explosion of its gases. But while thin skylights are contended for by many expert firemen, it should be borne in mind that nothing so facilitates the spread of fire as a draught, and it would be better to have the skylights adjusted with appliances for opening them, so that when the firemen arrive on the ground, and not before, they may be adjusted to permit the escape of smoke and allow the firemen to enter the building to see where to work to the best advantage. Under any circumstances a network of wire should be above the glass to guard it against flying embers, and another should be suspended beneath the skylights, so that when the glass cracks and breaks with the heat it will not injure the firemen below.

Roofs.

These should be of brick or tile on all high buildings, the roof beams being of iron and, where tanks are supported, of sufficient strength to carry many times the actual probable weight of the water and the containing tank itself.

Slate Roofs.

Slate roofs, on very high buildings especially, on street fronts are objectionable, as, in case of fire, the slates would crack and, falling to the street, injure the firemen. A flat roof of brick tile is better than any other.

All water on roofs from rain or melting snow should be drained from the front or sides to leaders, so as to avoid drip points, from which icicles could be formed.

Too little attention is paid to the great danger of injury to pedestrians from falling snow or icicles on very high buildings. This may not be a suggestion strictly germane to this article, but it is a matter so often overlooked as to warrant its being referred to in an article intended to deal more or less thoroughly with the subject of "fire-proof" buildings.

Electric Light Installation, Dynamo Room, etc.

The electric light installation of a "fire-proof" building is an important and complicated matter. To insure safety, reference should be made to the rules of the National Board of Fire Underwriters, which can be obtained, without charge, from the nearest local board of underwriters.

The switchboard should be of incombustible material, and no steam, water, or sprinkler pipes should pass over or near it where, in case of a bursting pipe, water could reach the switchboard and cause disaster. This is an important matter almost universally overlooked.

An admirable floor for a dynamo room is one of deck glass, ¾ in. thick, on a wooden (not iron) frame. It will insure that the attendant upon the dynamos will be, at all times, effectually insulated. Such a floor will not become soaked with oil, as would a wooden floor, and can easily be kept clean. A strip of rubber floor carpet stretched over it will prevent slipping. The Continental Insurance Company has, probably, the only floor of this kind in the country in its large "fire-proof" office building on Cedar Street, New York.

Communications between adjoining Buildings.

It is sometimes necessary to have communications between adjoining buildings by doors in the fire walls, and it is not always convenient, for changing merchandise from one room to another, to have "fire-proof" doors closed during working hours. It is possible to have the "fire-proof" doors run upon trolleys on an inclined track, so as to close by the force of gravity, and held open by fusible metal latches or links which would release them when melted by the rising temperature of a fire. It has occurred to me that this difficulty may also be met by erecting between two adjoining buildings a separating

"fire-proof" hallway of brick, which can be utilised for containing staircases and elevators, and for supporting the water tanks of automatic sprinklers. The doors which open into this hallway should not be opposite each other, but at opposite ends of it, so that fire in one of the buildings passing through the door would come against a blank wall opposite. Even if the "fire-proof" doors to these openings should happen to be open at the time of a fire in one of the two buildings, it is improbable that it would find access to the other.

Waterproof Floors.

The floors should be both fire and water proof, slightly lower than those of the two separated buildings, and with water vents or "scuppers" for carrying off surplus water thrown by a fire department. Indeed, it is well to have "scuppers" on all floors of every building.

The walls of this separating hallway or vestibule should rise 4 ft. higher than the roofs of the two buildings, and, if there are window or door openings near it, its walls should project beyond the line of enclosing walls at least 1 ft.

Water Tanks.

The water tank, as already stated, should be supported on protected iron I-beams, resting on the brick walls, with cast-iron templates, so that the tank cannot fall, break down the staircases and wreck the building in case of fire.

It is important always to locate tanks so that they will not be over stairways or elevators, and endanger them in case the supports give way. With a "fire-proof" hallway of the kind recommended, containing no combustible material whatever, the tanks being supported by iron I-beams resting on the brick walls, this would not be an important matter, but in all other cases water tanks should be planned so as not to endanger staircases, and the supporting iron beams should be "fire-proofed," that is, covered with "fire-proof" material.

It ought to be unnecessary to state that there should be no combustible material whatever in this separating hallway, and that the staircase, elevators, etc., should be of metal and "fire-proof."

Separation of Wooden Buildings.

Indeed, such a hallway as this could be relied upon to separate wooden buildings. It should, however, for that purpose, be at least 10 ft. higher than the peak of their roofs, and should extend 4 ft. beyond their front and rear lines. It is probable that the extensive frame dairy buildings of ex-Vice-President Morton at Ellerslie, which burned several years ago, might have been saved by this simple precaution.

Outside Staircases.

Where it is not necessary to transfer merchandise from one building to another, and only requisite to have a passageway for employees, this may be arranged by an iron balcony, like a fire escape, cutting down the window on each side of the separating wall for a door, so that communication can be had by the balcony. The openings should have "fire-proof" doors. This would be practically safe. It might, with iron ladders, be utilised as a fire escape, and so prove of great advantage to firemen in fighting a fire, who could hold a hose nozzle at the different windows with perfect safety to the last moment. It is practicable, indeed, to have iron stairways with roofed balconies entirely outside of storage stores so that the floors do not communicate. There is a number of these in Philadelphia.

"Fire-proof" Doors and Shutters.

These should not be of iron, but of wood covered with tin. Solid iron shutters or doors are not reliable. Iron doors yield readily to flame, resulting sometimes in their warping open when exposed to fire in an adjoining building, exposing the one they are intended to protect to the full effect of the flames.

Where window openings are protected by iron shutters on rear courts they are almost certain to be opened by a fire in an exposing building, and cannot be relied upon. The tin-covered wood shutters are alone reliable. There is no recorded instance in which a solid iron door, exposed to the full effect of fire in an adjoining building, has protected the opening, whereas there is, on the other hand, no recorded instance in which the "Underwriters'" door has failed to serve its purpose—two important facts which are significant and ought to settle the question.

The "Underwriters'" door is constructed of ordinary white pine lumber, free from knots, of double or treble thickness, according to width of opening, the boards being nailed diagonally and covered with the best quality of tin, with lap-welded joints.

It ought to be unnecessary to state that on the exposed side of a building, not only the shutter, but the window-frame, sash, etc., should be of metal or covered with metal—riveted, not soldered. Where it is not possible to use a "fire-proof" shutter for want of room, wire glass in a metal frame will be found a desirable substitute. It will probably hold a fire until the fire department can cope with it.

It is not generally understood nor known that fire will travel from one story to others above by way of the windows in the outer or enclosing walls. Especially where a building has an enclosed court, it will sometimes reach upper stories in this way, even when the floors themselves are thoroughly cut off, the court acting as a chimney. This happened several years ago in the Temple Court Building, a "fire-proof" structure in New York. The woodwork on several floors was ignited by the lapping of fire through the windows from the lower stories, and serious damage resulted. A recent instance was the Livingston Fire-proof Building in New York, in January, 1898. All windows on exposed sides should be protected with fire-resisting shutters.

It may be well to suggest for the benefit of those who are not familiar with city fires that, as heat naturally ascends, the exposure of a low building is often much greater to a neighbour higher than itself than to a building of its own height, so that a tall, "fire-proof" structure, surrounded by smaller buildings, should be provided with fire shutters to all openings. These are not necessary where the exposing buildings are occupied for offices, and are themselves "fire-proof," as the amount of heat which escapes from the windows of a burning building, so long as its enclosing walls remain intact, is seldom sufficient to ignite a "fire-proof" building

or its contents. The moment of greatest danger is when a burning building collapses, and the intense heat caused by its enormous bed of coals, exerts its full effect upon surrounding structures. In a recent fire in New York (Feb. 11th, 1898), three "fire-proof" office buildings were more or less damaged with their contents, although many feet away from the burning building.

It is to be hoped that some inventive genius will devise a plan for simultaneously opening or closing the shutters on any or all stories of high buildings by manipulation from the ground floor. They are usually left open at night, always in the day time, and might thus be closed in case of a dangerous fire in the vicinity. In some cases they are fastened open.

Comparative Tests of "Fire-proof" Material.

Tests of "fire-proof" material, iron beams, pillars, floor arches, etc., to be of any value must be conducted under circumstances which insure uniform conditions. Otherwise comparisons are unreliable. It is quite customary to refer to results of fires in different buildings, having differing forms of construction, as supporting theories of relative merit; but ordinary conflagrations cannot be relied upon, for the reason that in two buildings, side by side, the conditions may be widely different. Eddies and currents of air, changes of prevailing wind, etc., may secure exemption from damage. It happened in the large conflagrations of Chicago, Troy, Boston, etc., that the most phenomenal escapes were observed. In some instances frame buildings, surrounded by brick structures which were totally destroyed, escaped with no further damage than the blistering of paint.

Even where tests are carefully arranged, especially weight tests, obvious precautions are sometimes overlooked. It will be observed, for instance, where bricks are piled on a surface of floor arch and iron beams to secure a certain weight per square foot, the pile of bricks may be so disposed as to have a bearing on both of the iron beams and the full weight may not come upon the "fire-proof" arch between them. The lateral bond of a pile of bricks a few courses higher than the floor to be

tested may have all the effect of a relieving arch and materially reduce the strains. In furnaces constructed to secure high temperatures, drafts and currents of air should be provided for with great care and under the direction of the most competent and intelligent experts.

Conclusion.

In conclusion it may be well to state, in view of the general misapprehension which prevails with regard to the interest of the fire underwriter in the improvement of construction, that it makes no difference to him whether a building be "fire-proof" or not; his rate of premium and the amount which he insures are both based upon the characteristics of each building insured. He would make just as much money on $100 of premium secured at a rate of 5 per cent. for $2,000 insurance on a wooden planing mill as on $100 of premium secured on $100,000 insurance on a "fire-proof" building the rate of which is $1 per $1,000.

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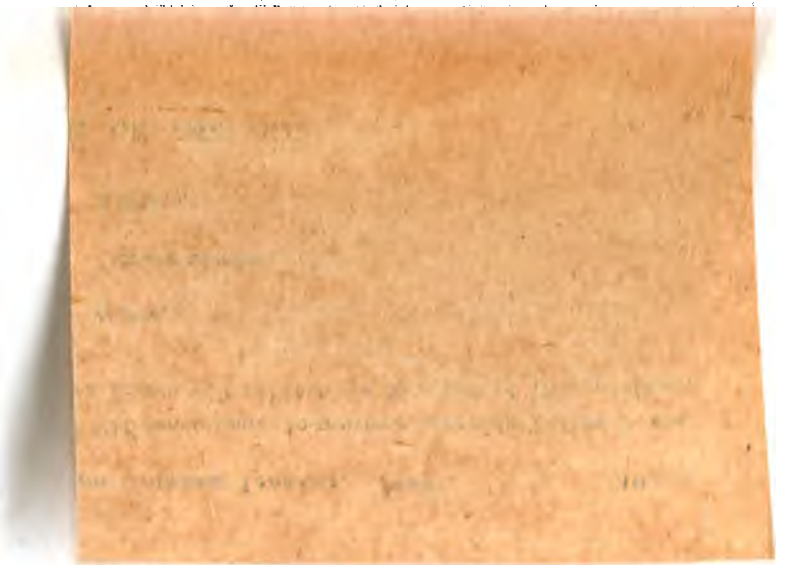

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